AD-A102 624 DEFENSE SYSTEMS MANAGEMENT COLL FORT BELVOIR VA F/G 5/1
CONCEPTS. THE JOURNAL OF DEFENSE SYSTEMS ACQUISITION MANAGEMENT--ETC(U)
1981

UNCLASSIFIED NL

1 OF 2
AD A
02624

LEVEL III

12

Concepts

The Journal of
Defense Systems
Acquisition Management

Summer 1981
Volume 4
Number 3

Concepts The Journal of Defense Systems Acquisition Management Summer 1981

Concepts (formerly the *Defense Systems Management Review*) (USPS 526-630) is published quarterly by the Defense Systems Management College, Fort Belvoir, Va. 22060, and is intended to be a vehicle for the transmission of information on policies, trends, events, and current thinking affecting program management and defense systems acquisition.

Statements of fact or opinion appearing in *Concepts* are solely those of the authors and are not necessarily endorsed by the Department of Defense or the Defense Systems Management College. Unless copyrighted, *articles* may be reprinted. When reprinting, please credit the author and *Concepts*, and forward two copies of the reprinted material to the Editor.

Submission of manuscripts and other correspondence is encouraged and should be addressed to the Editor. Inquiries concerning proposed articles or distribution may be made by phone at (703) 664-5082 or AUTOVON 354-5082. Controlled circulation rate entered at Fort Belvoir, Va.

POSTMASTER: Send address changes to Editor, *Concepts*, Defense Systems Management College, Fort Belvoir, Va. 22060.

Concepts

The Journal of
Defense Systems
Acquisition Management

Summer 1981
Volume 4
Number 3

Concepts

The Journal of
Defense Systems
Acquisition Management

Summer 1981
Volume 4
Number 3

from the editor...

On July 1, the Defense Systems Management College celebrated 10 years of service to the defense acquisition community. During those 10 years, about 10,000 students passed through DSMC on their way to challenging assignments in systems development and acquisition. In addition to these resident students, countless other acquisition managers were able to improve their skills through one or more of DSMC's off-campus courses, or through reading *Concepts* or *Program Manager*.

Those of us on the publications staff see ourselves as an adjunct to the educational program of DSMC. In our view, DSMC publications are a medium of continuing education for all acquisition managers, industry and government, whether or not they have had the opportunity to visit or attend courses at DSMC. For that reason, we seek to publish papers that will enhance the ability of the acquisition manager to do his or her job.

One of the more significant challenges facing DSMC today is to find ways to make the specialized training of DSMC available to a larger segment of the acquisition community. Tied in with this is the need to identify the particular educational requirements of defense acquisition managers at various stages in their careers so that those needs can be met in the most comprehensive way. Some of the steps the College is taking to meet these challenges are outlined in the July-August issue of *Program Manager*.

As DSMC enters its second decade, we look for a continued evolution of our publications program. We hope to be able to publish more special publications and monographs in addition to our regular periodicals. As the College gets more deeply involved in research, we expect to expand our role in the information dissemination mission of the College by publishing the results of that research in the most appropriate form. All of this is intended to help develop in our audience both the professionalism and expertise so necessary to success in the acquisition business. If you have any ideas or suggestions as to how to do that job, let us hear from you.

In the editor's note to the last issue of *Concepts*, I noted our regrets at the imminent departure from the publications staff of Susan Pollock, long-time Editorial Assistant and unofficial keeper of things in order. Even as we bid her farewell, there wasn't a one of us who didn't selfishly wish she weren't going. Well, selfish or not, our wishes came true: Susan has rejoined our staff and not a moment too soon. She seems to have sensed just how long it would take us to render ourselves into a state of terminal confusion, and returned just in time to prevent it. We're glad to have her back.

RHM

7

A Contingency Approach to Acquisition Planning

Robert F. Williams
Duane D. Knittle

One of the primary initiatives embodied in the recent policy guidance issued by the Office of Management and Budget (OMB) and the Department of Defense (DOD) is to stress the importance of comprehensive planning at the outset of the major system acquisition cycle. For example, OMB Circular A-109 states that an acquisition strategy should be tailored for each program as soon as the agency decides to solicit alternative system concepts. Paralleling this emphasis, DOD Directive 5000.1 (DODD 5000.1) requires each responsible DOD official to ensure that an acquisition strategy is developed and tailored for each major program. The latter guidance is further amplified by DOD Instruction 5000.2 (DODI 5000.2), which defines an acquisition strategy as the conceptual basis for the program manager's (PM's) overall plan for program execution and requires its generation as soon as possible after Milestone 0.

The purpose of this early planning is to provide overall direction to the acquisition effort. Toward this end, acquisition planning must satisfy two primary criteria. First, while the emphasis is properly on near-term activities, planning must address the entire acquisition cycle. Failure to accomplish long-term planning for a given activity can lead to subsequent difficulties in attaining that aspect of the program's objectives. For example, failure to secure the government's rights to the evolving technical data package may foreclose future competitive options. Second, acquisition planning must be comprehensive in its functional coverage. It must integrate—and if necessary prioritize—many diverse requirements in coordinating the approach to be employed for the acquisition at hand. Such prioritization may require that the program manager arbitrate necessary compromises among divergent functional objectives. This is a difficult task, but one which must not be taken lightly, as failure to adequately integrate all planning elements can lead to functional discord during later phases of the acquisition cycle. For example, an inadequate trade-off analysis can result in the acquisition of a system which is technically superior, but prohibitively costly to support.

The preceding discussion is by no means exhaustive in its treatment of the ac-

Robert F. Williams is Chief, Test and Evaluation Group, Army Procurement Research Office, Army Logistics Management Center, Fort Lee, Va. He has consulted with program managers of a number of the Army's major development programs on such topics as source selection and acquisition strategy. Mr. Williams holds a B.S. degree in aeronautical engineering from the University of Wyoming, a master of commerce degree from the University of Richmond, and is a candidate for a Ph.D. in marketing at the University of Alabama.

Duane D. Knittle is a Procurement Analyst with the U.S. Army Procurement Research Office, Fort Lee, Va. He has held other civilian positions in the procurement and contracting field with the U.S. Army Missile Command, the U.S. Army Munitions Command, and the Defense Contract Administration Services. Mr. Knittle holds a B.A. degree in political science from Central Missouri State University, and an M.B.A. degree in procurement and contracting from The George Washington University.

quisition planning process. It is only intended to illustrate the complexity inherent in establishing the goals and objectives of the acquisition effort.

Having gone through this process, the program manager has essentially determined *what* should be done to assure a successful acquisition. The question then arises as to *how* the government should proceed in order to attain these planning objectives.

The determination of how to proceed with the acquisition is largely a function of the acquisition plan discussed under Section 1-2100 of the Defense Acquisition Regulation (DAR 1-2100). This regulatory guidance covers procedures for developing and updating the acquisition plan. It also provides an illustrative format for the plan itself. Of primary interest to us here is the emphasis placed on the dual responsibilities of the program manager and his supporting contracting officer in formulating the acquisition plan. That is, while the program manager is properly tasked with the overall responsibility for acquisition planning, the contracting officer must develop and maintain the formal acquisition plan itself. In order to fulfill his obligations, the contracting officer must rely on the program manager to provide the planning parameters related to the overall effort (i.e., to provide guidance as to *what* must be accomplished). Conversely, the program manager is dependent on the contracting officer to formulate an acquisition plan that will support attainment of the systems objectives (i.e., to determine *how* the acquisition should proceed). The remainder of this paper will explore the inherently contingent nature of acquisition planning, with particular emphasis on how the program manager and contracting officer should approach the task of formulating a formal acquisition plan. Figure 1 illustrates the interdependence of these two participants in the planning process. The terms reflected in the figure—alternatives, objectives, conditions, strategy, and tactics—are discussed in some detail in the ensuing paragraphs.

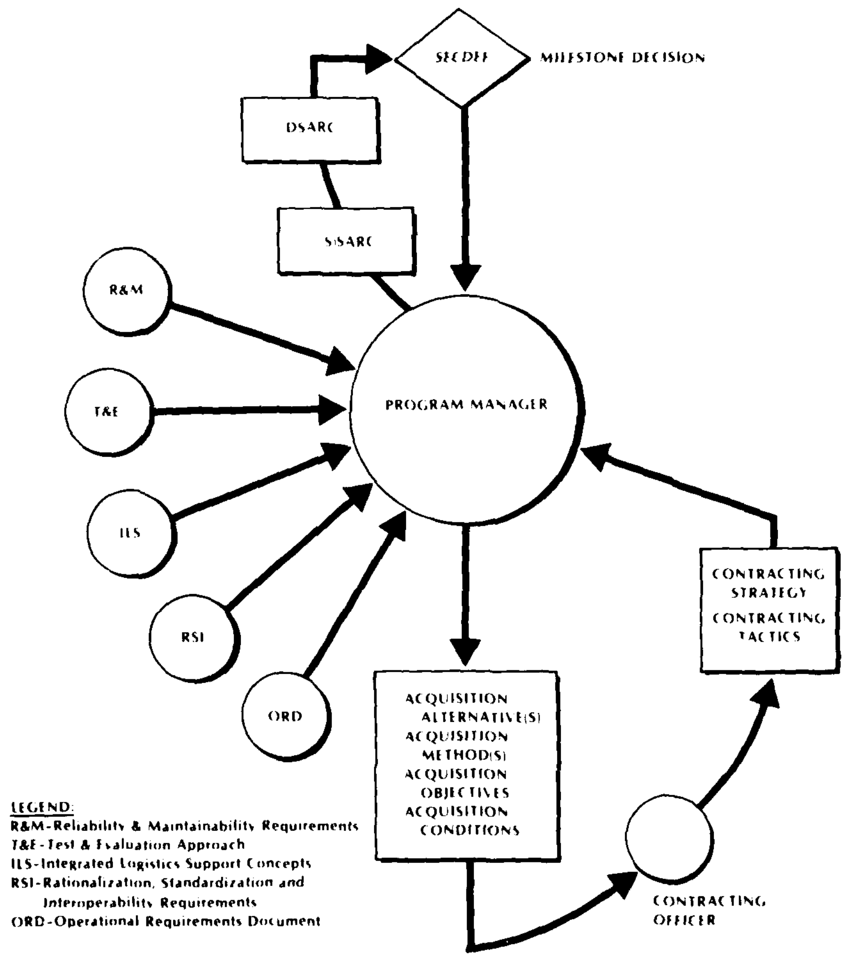
Acquisition Alternatives

The authority to decide which (if any) system candidates (i.e., alternatives) are to be carried forward into the next phase of the acquisition cycle rests with a decision-maker above the program manager level. Thus, the selection of acquisition alternatives is beyond the direct control of either the program manager or the contracting officer. While the program manager may influence the decision-maker, the contracting officer has little or no responsibility in this regard. Consequently, the alternatives to be pursued can be viewed as "given" for purposes of developing the acquisition plan. Nevertheless, the selected alternatives provide the framework for choosing among available acquisition methods and for tailoring these methods to fit the needs of the situation at hand.

Acquisition Methods

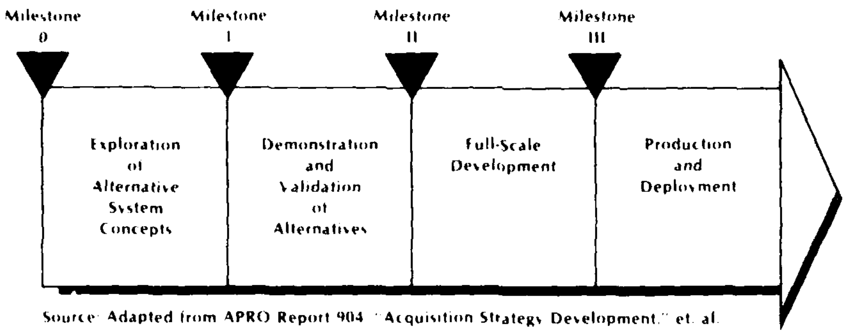
Each selected system alternative will suggest a general method for its acquisi-

FIGURE 1
Acquisition Planning Process Model



tion. Such acquisition methods can be grouped under the following categories:
—Product improvement of current standard equipment;
—Purchase of non-developmental equipment;

FIGURE 2
New Development Program



Source: Adapted from APRO Report 904 "Acquisition Strategy Development," et. al.

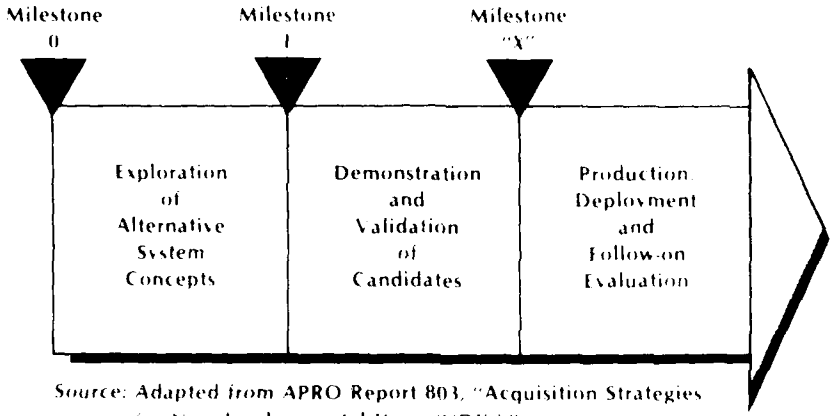
—Modification of commercially available items;
—Initiation of a new development program.

The first step in the planning process should be to determine which acquisition method is appropriate to the situation. Having done this, the selected method should be modeled in order to establish a broad framework for tailoring an acquisition strategy.[1] Figure 2 illustrates a model for the initiation of a new development program. This should be compared to Figure 3, which provides a similar model for the purchase of a non-developmental item. The differences in complexity of these two acquisition methods should be readily apparent. In essence, they represent the poles of a complexity spectrum. Product improvements and modification of commercially available items would fall somewhere between these poles, depending largely on the magnitude of technological change being sought. That is, if the increment of technological change is relatively large, the nature of the effort will take on the characteristics of a new development. Conversely, if the increment of change is minor, the effort will approach the method for acquisition of non-developmental items.

It can be seen that the nature of the alternatives to be pursued largely dictates the basic acquisition methods to be employed. Like the alternatives themselves, these general acquisition strategy models (i.e., basic methods) may be viewed as

1 For purposes of this paper, an acquisition strategy is viewed as a composite reflection of the broad concepts which will direct and control the overall acquisition process. The acquisition plan builds upon this strategy to formally document the definitive actions which must be accomplished at various phases of the acquisition cycle.

FIGURE 3
Non-developmental Item



Source: Adapted from APRO Report 803, "Acquisition Strategies for Non-developmental Items (NDI's)."

"givens"; however, the selection of the most appropriate methodology is the first critical step in acquisition planning. In order to further refine these general methods, they must be tailored to fit the situation at hand. Although the selection of an acquisition method and the tailoring of the methodology are largely the responsibility of the program manager, these activities provide key information to the contracting officer upon which to develop the formal acquisition plan.

Acquisition Objectives

In order to begin tailoring the basic acquisition method to be employed, the program manager must carefully analyze and prioritize the objectives of the acquisition effort. It must be recognized that programs vary in what they attempt to accomplish. Every acquisition has the overall goal of obtaining a system which meets user needs in a timely manner and at a reasonable price; however, optimizing each of these goals is often unrealistic. The policy governing major system acquisitions explicitly recognizes the need for goal prioritization by stating that agencies should ". . . ensure appropriate trade-off among investment costs, ownership costs, schedules, and performance characteristics."[2] While such trade-

2. U.S. Office of Management and Budget, Circular No. A-109, "Major System Acquisitions" (Washington, 1976), p. 4.

off analyses are generally associated with choosing among competing system candidates, the principle is equally applicable to selecting from among alternative strategies. For example, if it is imperative that a given system meet a prescribed initial operational capability (IOC) date, the acquisition schedule might become the top priority objective. A strategy could then be tailored to ensure against schedule slippage, while recognizing that certain cost saving opportunities and/or technological advances may have to be foregone.

This is a highly simplified portrayal of an extremely complex process; nonetheless, it illustrates the fact that difficult trade-off decisions must often be made when selecting among competing objectives. All too often such decisions are ignored, and an aura of undue optimism permeates the planning process. While the optimization of every acquisition objective may be a worthy goal, attainment of each objective is often infeasible. The program manager should, therefore, perform a comprehensive trade-off analysis at the outset in order to make realistic decisions as to which strategies are appropriate for pursuing the system's highest priority objectives.

Acquisition Conditions

Once the system's objectives have been analyzed and prioritized, the conditions affecting the acquisition must be examined. In order to provide structure to this examination, a comprehensive list of possible conditions should be developed and evaluated. A suggested grouping of acquisition conditions is as follows:

1. System Characteristics.
   —Technological complexity
   —Technical, cost and schedule risk
   —Work breakdown structure
   —Technical data package/specifications
   —Etc.
2. System Requirements.
   —Threat
   —Mission need
   —Projected quantity
   —Subsystem compatibility
   —Operating conditions
   —Reliability and maintainability
   —Rationalization/standardization/interoperability (RSI)
   —Etc.
3. Government Resources.
   —Personnel capable of planning in each functional area
   —Personnel capable of implementing planned actions in each functional area
   —Overhead
   —Etc.

4. Marketplace.
   —Number of capable firms
   —Number of interested firms
   —Characteristics of capable/interested firms (e.g., labor/capital intensive, development/production orientation)
   —Financial condition of capable/interested firms
   —Government/commercial sales of capable/interested firms
   —Availability of plant capacity
   —Etc.
5. External Conditions and Constraints.
   —Political factors
   —Economic conditions
   —Socio-economic conditions
   —Energy constraints
   —Environmental constraints
   —Etc.

As these conditions are analyzed in light of the system's prioritized objectives, appropriate strategies should begin to suggest themselves. Let's assume, for example, that the highest priority objective is to minimize production costs. Turning to conditions, let us further suppose that the analysis reflects a relatively low technical risk, a good pool of capable/interested firms, and the availability of adequate contracting personnel. This combination of objectives and conditions would almost certainly lead to the selection of a competitive strategy for follow-on production; however, there are a number of competitive strategies which might be utilized (e.g., direct licensing, leader-follower, or acquisition of the technical data package), and further analysis will be required to determine which would be most appropriate. It is at this phase of the planning process that the contracting officer begins to play a prominent role.

Contracting Response: Strategies and Tactics

While the contracting officer should contribute certain insights as to the conditions affecting the acquisition (e.g., characteristics of the marketplace, socio-economic requirements), his participation begins in earnest with the development of the formal acquisition plan to support the program manager's strategy. In this regard, it will be assumed that the acquisition plan will follow the format suggested by DAR 1-2100. Therefore, rather than concentrating on *what* the plan should contain, we can turn to *how* the plan should be developed.

It is suggested that the first step in developing the acquisition plan should be to develop a contracting strategy. In essence, the contracting strategy should be a refinement of the program manager's acquisition strategy which concentrates on the establishment of a business relationship (or more properly, a series of relationships) with the private sector. Returning to the example discussed under acquisition conditions" above, let us make certain additional assumptions about this hypothetical situation.

First, it will be assumed that the technical data package is adequate for competition, but not definitive enough to allow for formally advertised placement. This would result in a contracting officer determination and findings that negotiated placement is appropriate under the authority of DAR 3-210.2(xiii), and contract planning could commence accordingly. At this point, contractual alternatives would include direct licensing, a leader-follower arrangement, and buy-out competition based on the validated technical data package. However, if we further assume that the design/development contractor is not expected to be particularly cooperative in qualifying a second source, the alternatives of direct licensing and leader-follower become much less feasible. Thus, the analysis of relevant conditions leads to the conclusion that a competitive buy-out is the most appropriate strategy under the circumstances. The reader is again cautioned that all conditions surrounding the acquisition are not covered by the above analysis, and that the stated assumptions effectively limit the strategies considered. Nonetheless, this example illustrates the basic methodology advocated by this paper—that is, the selection of a contracting strategy is contingent upon both the objectives of the acquisition effort and its attendant conditions. A more comprehensive listing of possible contracting strategies is provided in Figure 4.

As a final comment, the contingent nature of acquisition/contract planning, it should be noted that certain of the conditions set forth in the preceding section are subject to alteration if comprehensive planning is accomplished early in the life cycle. For example, had action not been taken to secure unlimited rights to the validated technical data package during the development phases of the cycle, the competitive strategies discussed above would have been foreclosed.

Assuming stable objectives, the set of conditions surrounding the acquisition represents the most manageable aspect of strategic planning. While not all such conditions are susceptible to management action, many potentially adverse conditions could be obviated by proper long-range planning. Thus, the approach we envision includes both the elimination of unnecessary contingencies during the early phases of the cycle, and the systematic analysis of and reaction to unavoidable contingencies during the latter phases. It is once again emphasized that this should be a team effort of the program manager and the contracting officer. While each of the strategies set forth in Figure 4 would require contractual implementation, it becomes difficult to make a fine distinction between acquisition and contract planning in every case. Suffice to say that each individual has a distinct, yet supportive, role to play in the generation and implementation of such strategies.

The selection of contracting tactics, on the other hand, is almost solely within the purview of the contracting officer. A partial listing of potential contracting

FIGURE 4
Representative Contracting Strategies

- **Open Competition**
- **Design Competition**
- **Prototype Competition**
- **Buy-Out Competition**
- **Acquisition of Technical Data Package (for subsequent competition)**
- **Dual Source Production**
- **Parallel Undocumented Development**
- **Contract Subdivision**
- **Leader Follower Arrangement**
- **Licensing**
- **Breakout**
- **Successive Sole-Source Contracts**
- **Concurrency**
- **Production Options During Research and Development**
- **Sequential Development and Production**
- **"Skunkworks"**
- **"Red Team" Review**
- **Second Contractor Review**
- **Etc.**

tactics is provided as Figure 5. It can be seen that each tactic is strictly concerned with establishing the formal contractual relationship with industry. In this sense they are properly viewed as the vehicles for implementing the contracting and (by extension) the acquisition strategy.

In a sense, implementation of the contracting strategy can be viewed as the consummation of the acquisition planning process. The agent which bridges the gap between planning and execution is the formal acquisition plan.

Documentation: The Acquisition Plan

Once the process described above has been completed, all that remains is to formally document its results in a comprehensive acquisition plan. Figure 6 illustrates the relationships of the various functional strategies and plans to the overall acquisition plan. Upon execution by the program manager and contracting officer, the acquisition plan becomes the document of record for the time-phased implementation of the acquisition strategy. It also serves as a baseline for

FIGURE 5
Representative Contracting Tactics

CONTRACT TYPE & PRICING ARRANGEMENT

- Firm Fixed Price
- Fixed Price Incentive
- Fixed Price with Economic-Price Adjustment
- Cost Reimbursable
- Cost Plus Fixed Fee
- Cost Plus Award Fee
- Cost Plus Incentive Fee
- Etc.

CONTRACT PROVISIONS

- Warranty
- Pre-Production Evaluation
- Investment Protection
- Design to Cost
- Value Engineering
- Data Rights Clause(s)
- Etc.

EXTRA-CONTRACTUAL

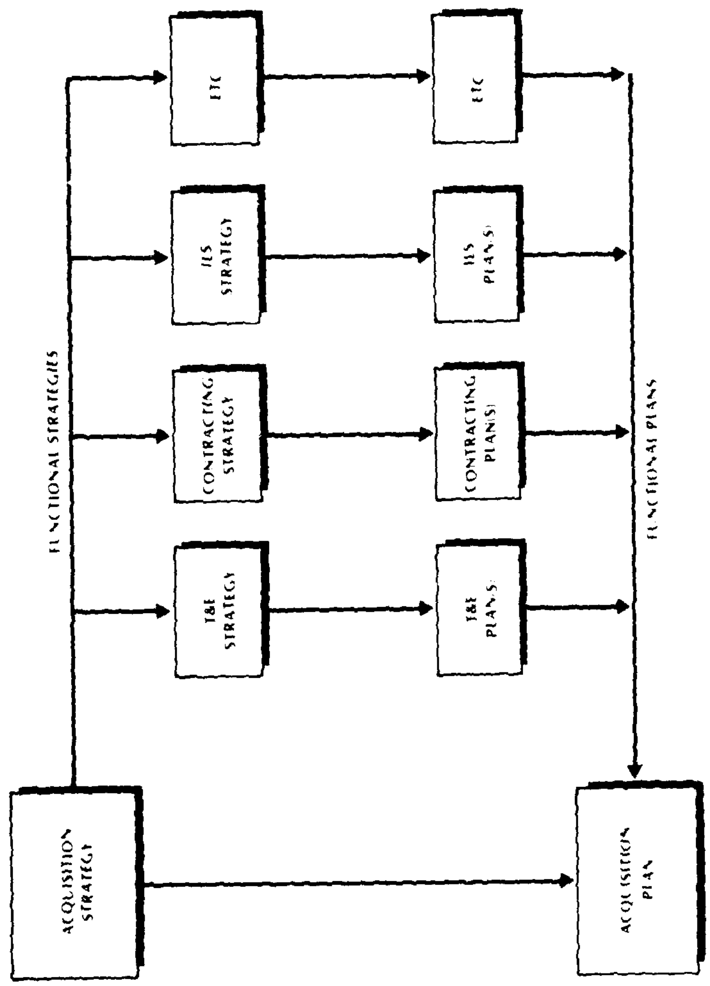
- Level of Contract Administration
- Should Cost
- Pre-Award Survey
- Post Award Conference
- Appeal to Patriotism
- Etc.

updating and revising the strategy as the life cycle progresses. Viewed in this light, it provides a historical audit trail of the system's evolution.

Toward More Systematic Planning

In order to logically approach the selection of the most appropriate contracting strategies and tactics, the contracting officer must receive certain key information from the program manager. This information includes the alternatives to be pursued, their attendant acquisition methods, the prioritized system objec-

FIGURE 6
Acquisition Planning Relationships



tives, and the relevant conditions which affect the acquisition. He should also have access to historical data so as to learn which strategies and tactics have worked well under similar circumstances. And in the final analysis, he must apply his own judgment in analyzing this information. Given the amount of information that must be assimilated, this is no easy task.

The question arises as to how this information might be displayed to provide a structured framework for the contracting officer's deliberations. Figure 7 presents a suggested approach in this regard. As in our previous example, the contracting officer is concerned with the primary objective of lowering production costs. Possible conditions are displayed vertically, while potential strategies are arrayed horizontally. In practice, the contracting officer would identify those conditions which are relevant to the acquisition at hand and cross check to determine which strategy or strategies might be most appropriate. In the example presented, all conditions favor some form of competitive strategy with the exception of the adequacy of the technical data package. Reference to the table would, therefore, tell the contracting officer two things. First, to attempt to engender competition *at this time* would be extremely risky. Second, the only action which needs to be taken to allow for competition *in the future* is to definitize and validate the technical data. Thus, the figure reflects a contingency table which can be of value in both the short and long terms.

Final Comments

To summarize, the planning steps advocated by this paper can be listed as follows:

1. Analyze selected alternatives;
2. Determine appropriate acquisition method;
3. Define and prioritize objectives;
4. Identify relevant conditions;
5. Array possible strategies and tactics;
6. Through empirical analysis, determine which strategies and tactics best match the prioritized objectives under the given conditions;
7. Formalize these strategies and tactics into a comprehensive acquisition plan;
8. Update strategies and tactics upon changes to the objectives and/or conditions, or as more knowledge is gained about the program.

If this approach were adopted and adequate records were kept, a series of contingency planning tables could be developed for each potential objective. These could then be used as *guides* for the individual contracting officer; however, they should by no means be viewed as "cookbooks" for contract planning, as they could not be expected to cover all potential situations. More importantly, sound

FIGURE 7
Acquisition Planning MATRIX

APPROPRIATE STRATEGIES (THEN . . .) / RELEVANT CONDITIONS (IF . . .)	DIRECT LICENSING	LEADER FOLLOWER	ACQUIRE TDP	SOLE SOURCE	ETC
1. SYSTEM CHARACTERISTICS					
• Technological Complexity					
High				x	
X Low	x	x	x		
• Technical Risk					
High				x	
X Low	x	x	x		
• Technical Data Package					
Validated	x	x	x		
X Unvalidated				x	
2. SYSTEM REQUIREMENTS					
• Quantity					
X High Volume	x	x	x		
Low Volume				x	
• Etc.					
3. GOVERNMENT RESOURCES					
• Technical Personnel					
X Available			x		
Unavailable	x	x		x	
• Etc					
4. MARKETPLACE					
• Available Sources					
X Multiple	x	x	x		
Single				x	
• Etc					

contract planning must continue to rely in large measure on the informed judgment of the contracting officer. What this methodology does offer is a structured approach to planning which would augment the contracting officer's judgment by drawing on the corporate experience of the government as a whole. A similar approach could be applied to other planning activities (e.g., logistics, testing). The challenge is now to develop the empirical data to construct reliable contingency tables.

21

A Working C/SCS for Naval Shipbuilding

G. Graham Whipple

Upon the award of the first two "Land" class submarine tenders to Lockheed Shipbuilding and Construction Co. (LSCC), in November 1974, the criteria of Department of Defense Instruction 7000.2 for cost schedule control systems was imposed.

The company reaction to this contract software requirement was initially mixed. LSCC had not participated in U.S. Navy new construction for several years, and was still nursing its wounds (along with other shipbuilders) from the naval construction fiasco of the 1960s. While it was felt that a better system for construction statusing and forecasting could be beneficial, the memories of a profusion of acronymic, customer-invented, and autocratically imposed management systems of the prior decade were still fresh in our minds. In retrospect, it is pleasing to report that the DODI 7000.2 concept that only sets criteria and encourages the contractor to invent and use his own workable system, along with a mature administrative approach by the Naval Sea Systems Command (NAVSEA), rather rapidly overcame our initial skepticism and got the job moving.

The first column of Figure 1 lists the mandatory criteria for all DODI 7000.2 systems without deference to program or product peculiarities. The working system objectives and features highlighted in Figure 1 are also of general import. The system objective can be even more succinctly stated as "How are we doing compared to where we ought to be, and how will it all end?" To continually provide the answer to that question, the system must feature:

—Visibility: Show us the facts as clearly as possible.
—Responsiveness: Let the facts be fresh information.
—Earned value: What did we get for what we paid?
—Integration of cost and schedules: Recognize that "when" continually interrelated with "how much."
—Responsibility definition: Who has control of the resources producing the results?
—Forecasting accuracy: What we can reasonably predict from current returns.

It is worth noting that the criteria, the system objectives and features represent a communal interest to NAVSEA and the shipbuilder. Furthermore, both have an interest in using the information generated by the system beyond the instant contract or program. The "spiral of refinement" shown in Figure 2 expresses this in contractor terms, but NAVSEA no doubt has its own verbs to label the cycle. We both want and need to continually refine our estimating base for future work.

G. Graham Whipple is Executive Vice President of Lockheed California Company. Previously he served as Group Vice President with overall responsibility for [illegible] Lockheed subsidiaries. He joined Lockheed in December 19[illegible] as President of [illegible] Company and as a Corporate Vice President. Mr. Whipple holds a bach[illegible] from Illinois State University.

FIGURE 1
System Criteria, Objectives, and Features

C/SCS CRITERIA	SYSTEM OBJECTIVES	SYSTEM FEATURES
• Organization • Planning & Budgeting • Accounting • Analysis • Revisions	• Performance Visibility • Focus For Comparing Current & Projected With Baseline • Accurate & Timely Forecasts	• Responsiveness • Integration Of Cost & Schedules • Responsiveness • Responsibility Definition • Visibility • Forecasting Accuracy • Earned Value

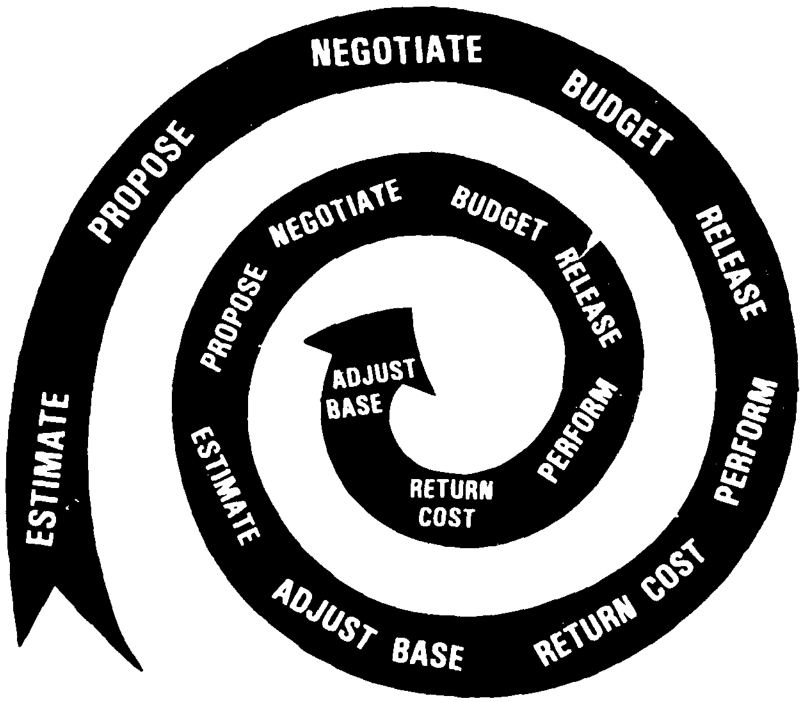
Figure 3 highlights the distinctive elements which characterize naval ship construction and Figure 4 gives us gross descriptions of the product. To gain a better appreciation of the ship, consider that each one has:

—Well over an acre of steel in each through deck;
—34 miles of completed pipe runs;
—120 miles of electrical conductor;
—1,500 foundation-mounted pieces of machinery;
—12 elevators;
—4,000 feet of monorail trackage;
—27,000 pieces of furniture.

NAVSEA visualizes the construction of the ship in a very neat manner, the ship work breakdown structure (SWBS) better known as the "nine-way breakdown." This is an engineering definition of the ship, proceeding from generic levels through major systems and subsystems to detail pieces. As shown in Figure 5, the various SWBS levels are assigned standard cost code numbers for cost accumulation to the configuration breakdown.

While this may be a most useful system for NAVSEA to look at costs of individual ships, make comparisons among various ships, and estimate cost of new

FIGURE 2
Product Financial Cycle



ships, it's not very helpful for running the shipbuilding day to day operations. Let's look at the particular hardware subsystem detailed in Figure 5, the firemain system, cost code 5060. About 2 years will elapse from the time the first pipe assembly is complete in the pipe shop until the last pipe run of the subsystem is installed in the ship and ready for system test. During the fabrication and installation of pipe for this subsystem, a few dozen other pipe-dominated subsystems are concurrently being manufactured and installed. Individual subsystem completion is much less of a driver than the necessity to work *all* pipe regardless of function in a given area as the ship grows incrementally on the shipway and at the outfitting pier. This not only provides for best use of pipe craft labor, but is even more driven by required sequences of other, and equally important non-pipe installations in the same, and often constricted, areas of the ship.

FIGURE 3
Nature of Program/Product

- Over Four Year Construction Span
- 5 Million Manhour Integrated Effort
- Multiplicity Of Crafts
- Blend Of Construction & Manufacturing
- Over 50,000 Line Item Bill Of Material
- Prime Contractor Management > 90% Of Supply Structure
- Incremental Testing To Support Finished Product Performance Test

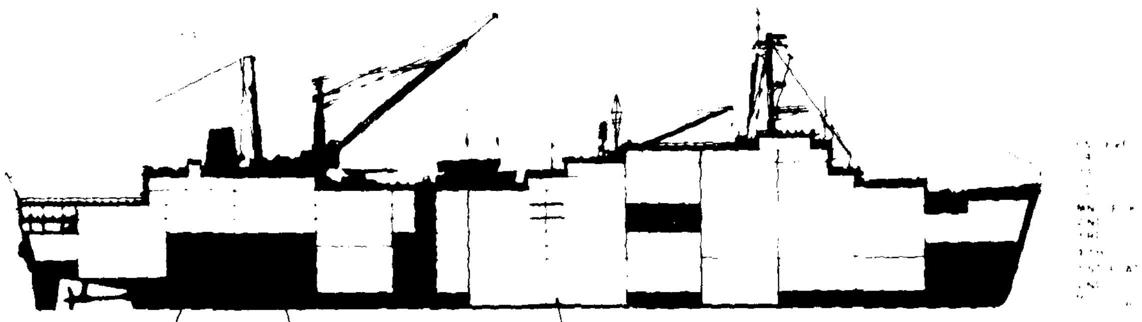
So we have a huge and complicated article to build; the customer needs the cost gathered up in one manner; and the shipbuilder for good reason has to do it in another. Since we differently define the beast by how we lay on our hands, it is perhaps apt to remember the six blind men of Hindustan who approached the elephant. There's only one good way to resolve the problem—find a least common denominator.

The "small bite" approach is the basis of our whole system. Figure 6 summarizes how we divide our particular beast into 180,000 bite-size pieces. A price (budget) is assigned to each piece, and rate of dining (schedule) is applied to similar bites. Actual consumption is compared to the menu to determine earned value.

To some, 180,000 may seem like a large number, but reference to Figure 7 seems to support that it's rather reasonable. We complete about 900 bites a week per ship, worth about 25 man-hours each, and each NAVSEA SWBS cost code is supported by about 100 performance building blocks.

About 20 percent of the direct labor hours going into the ship (Figure 8) are non "hands-on." Of these, systems test and trials is covered as measured work, just like the 80 percent craft labor. The remainder is time-related level of effort. On a subsequent new ship class, the LSD-41 landing ship dock, we are extending our system validation to cover original release engineering. There are clear opportunities to convert some presently levels of effort where a "countable" output exists for measurement, such as material planning/control and planning and scheduling.

FIGURE 4
AS-39 Land Class Submarine Tender



SHIPS CHARACTERISTICS

LENGTH	644 FEET
BEAM	85 FEET
FULL LOAD DISPLACEMENT	23,000 TONS
TOTAL COMPLEMENT	1,351 PERSONS
DECK LEVELS	13
COMPARTMENTS AND SPACES	913 (PLUS 107 TANKS)

FIGURE 5
Ship Work Breakdown Structure (SWBS)

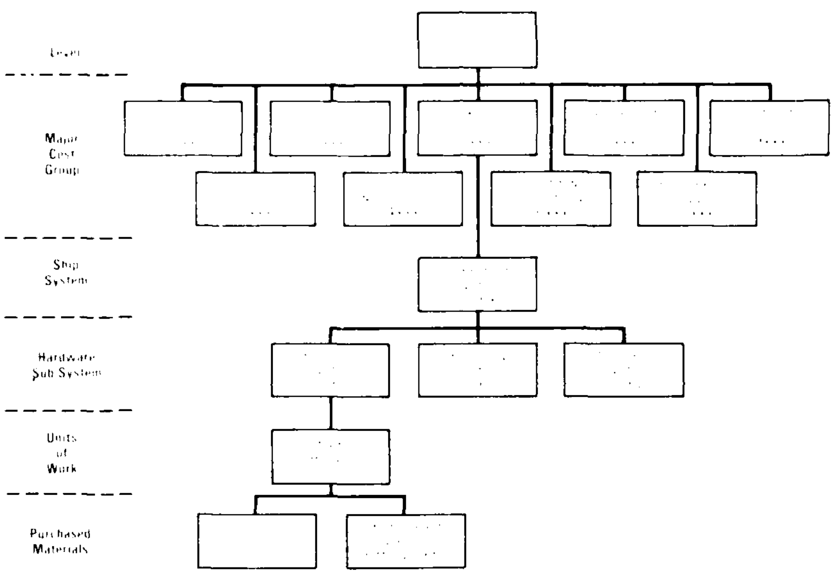


Figure 9 is a block diagram of the principal inputs and outputs of the system. It should be noted that although our "arithmetic" is performed with IBM-370 level hardware (which performs much other work) the system software is simple, and a low-capacity computer would handily perform the job on a stand-alone basis.

The "fine-tune" system element is man-hours, and rightly so, since shipbuilding is extremely labor intensive. Besides, the whole management structure right down to a working leadman in charge of eight people thoroughly understands it. Therefore, the basic weekly cost input is in direct man-hours, which is also the easiest way, since the same hours must be accounted for in payroll, which also allows us to accumulate labor dollars by extending the hours by the direct labor rate paid.

Man-hours expended and production unit count are weekly inputs. Material commitments and bookings are also reported weekly. Since practically all material activity is a one-time contract commitment, material detail by SWBS

FIGURE 6
Construction—180,000 Bites

ELEMENTS	WORK UNIT	UNITS COUNTED
Steel — Ship [illegible]	[illegible]	[illegible]
Shop — Plate [illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]
Pipe — Reg[illegible]	[illegible]	[illegible]
NSI	[illegible]	[illegible]
Mach[illegible]	[illegible]	[illegible]
Sheet Metal	[illegible]	[illegible]
Cable Plate [illegible]	[illegible]	[illegible]
Ship — [illegible]	[illegible]	[illegible]
Ste[illegible]	[illegible]	[illegible]
Shielded Assem[illegible]	[illegible]	[illegible]
Pipe — Regular	[illegible]	[illegible]
NSI	[illegible]	[illegible]
Machinery	[illegible]	[illegible]
Electrical	[illegible]	[illegible]
Sheet Metal	[illegible]	[illegible]
Joiner	[illegible]	[illegible]
Scalers	[illegible]	[illegible]
Painters	[illegible]	[illegible]

cost code and estimates to complete are performed on a monthly basis. Overhead applications are applied to monthly output reports, and adjusted annually (for the shipbuilder's overhead year) although more frequent adjustments are made if of amounts significant to total contract cost. All output reports show comparisons to planned budget and schedule.

The internal "how goes it" reports are available to all levels of management in identical format no later than the third working day following the end of a week's worth with the close of the day shift on Friday. Figure 10 is the weekly "budget schedule performance" covering each measured element; the sheet shown is for shops—similar ones are available for structural steel and outfitting. Figure 11, "Direct Labor Performance," covers about 50 line items describing the whole direct labor input and performance ratio (earned value) for the entire job.

Figure 12 is a sample of the "cost schedule summary" provided monthly both internally and to NAVSEA for every labor element. This is the classic DODI 7000.2 display which integrates both cost and schedule performance and trend against the reference PVWS curve.

It is apparent that the system is heavily oriented to the use of cumulative costs vs. time. One of the very useful fallouts of this approach can be seen in Figure 13.

FIGURE 7
Bite Digestion Rate

- $\dfrac{180{,}000 \text{ BITES}}{200 \text{ WEEKS CONSTRUCTION SPAN}} \approx$ 900 BITES WEEK

- $\dfrac{4{,}200{,}000 \text{ CONSTRUCTION M H}}{180{,}000 \text{ BITES}} \approx$ 25 MAN HOURS BITE

- $\dfrac{180{,}000 \text{ BITES}}{1830 \text{ WBS CODES}} \approx$ 100 BITES PER WBS CODE

For similar elements it is very easy to plot activities on log-log paper to produce a continuous labor progress curve which graphically extends to man-hours at completion.

In summary, Figure 14 shows how we've come out in relation to our objectives set down over 5 years ago. We have indeed designed a system appropriate to the peculiar nature of Naval shipbuilding which fully meets the DODI 7000.2 criteria, and that in fact *works*. The system, as is true of all systems, doesn't control cost and schedules—men do that—but they have been provided a powerful tool to manage their work.

FIGURE 8
Non-Construction Elements

MEASURED	—	Systems Tests And Trials (360 Items)
LEVEL OF EFFORT	—	Engineering
		Lofting
		Quality Assurance
		Tool Rooms/Cribs
		Materiel Planning/Control
		Production Control
		Master Scheduling
		Planning And Scheduling
		Production Salaried Supervision
		Other Production Administration
		Other Support - Program Office
		Reproduction
		Program Cost Analysis

FIGURE 9
Inputs and Outputs

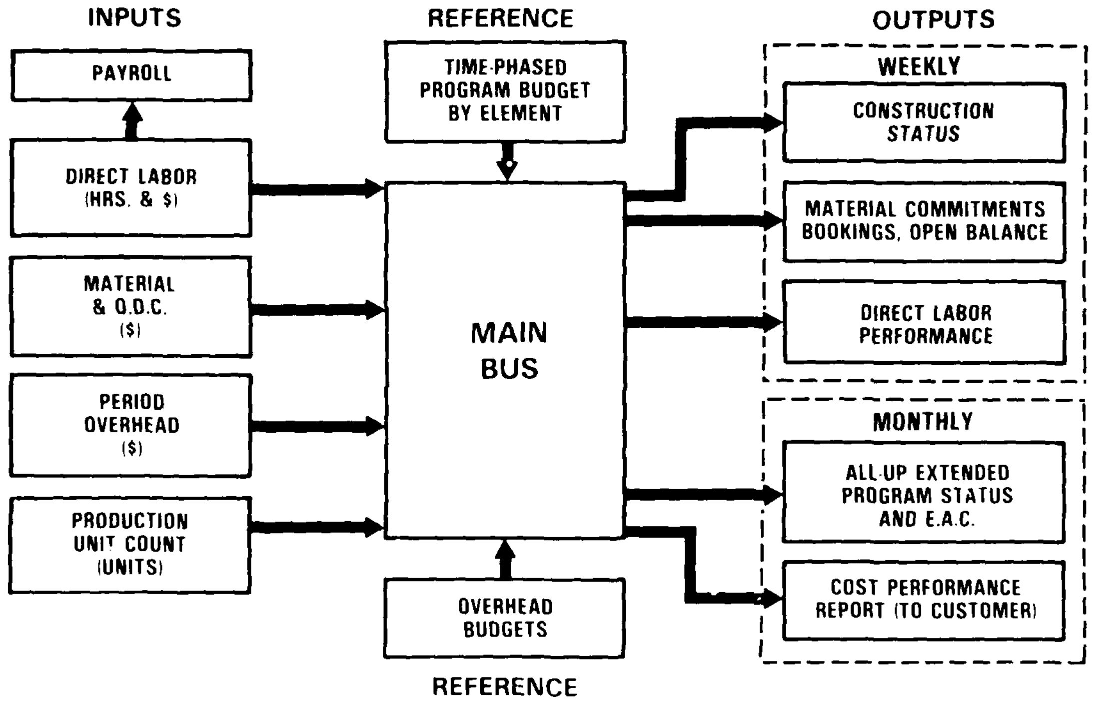


FIGURE 10
Budget Schedule Performance

SUBMARINE TENDER CONSTRUCTION STATUS			VESSEL AS 41				WEEK ENDING 4 25 80			
			THIS WEEK		CUMULATIVE				MANHOURS UNIT	
ELEMENT	UNIT OF MEASURE	QUANTITY PER SHIP	SCHEDULE	ACTUAL	SCHEDULE	ACTUAL	AHEAD (BEHIND)	TO GO	BUDGET DATED 9 20 78	TO DATE
SHOPS										
Plate - Prop. Foundations	Each	32	-	-	Compl.	-	-	0	72.3	58.7
Plate - Aux. Foundations	Each	1,669	17	2	1,241	1,658	417	11	14.3	15.1
Plate - Misc. Steel	Pieces	470	-	-	Compl.	-	-	0	26.6	28.1
Plate - Outfitting Steel	Pieces	5,209	35	3	4,688	5,031	343	178	9.5	9.1
Lead Shielding	Pieces	947	-	1	947	947	-	-	32.7	32.5
Pipe	Assy.	8,541	60	8	7,220	8,026	806	515	12.9	12.1
NSF Pipe	Assy.	495	3	-	425	492	67	3	60.6	37.6
Machine	Pieces	1,178	8	0	1,104	992	(112)	186	19.0	20.2
Sheet Metal	Assy.	24,272	115	74	21,589	23,174	1,585	1,098	3.6	4.5

FIGURE 11
Direct Labor Performance

DIRECT LABOR PERFORMANCE	PERFORMANCE SUMMARY	LAST WEEK	THIS WEEK	SHIP PROJECT	WEEK ENDING
	% TOTAL HOURS SPENT	66 22%	66 84%	AS 41	4 25 80
	% COMPL TOTAL CONTRACT	65 66%	66 27%		

ELEMENT	MANNING EQUIVALENT		TOTAL PROJECT BUDGET	PROJECT TO DATE			FOR THE WEEK		
	BUD	ACT		HOURS EXPENDED	HOURS EARNED	PERF RATIO	HOURS EXPENDED	HOURS EARNED	PERF RATIO
SHIP PIPE	140.2	108.0	656,159	356,160	421,107	1.18	4,322	5,524	1.28
TOTAL	480.8	425.3	1,941,722	1,061,783	1,172,018	1.10	17,018	18,237	1.07
QUALITY ASSURANCE	27.4	28.2	171,820	105,640	112,521	1.07	1,127	1,095	0.97
[illegible]	174.6	157.6	1,190,738	780,256	829,909	1.06	6,301	6,967	1.11
TOTAL	909.6	818 3	5,320,396	3,563,851	3,572,465	1.00	32,728	30,700	0.94

FIGURE 12
Cost/Schedule Summary

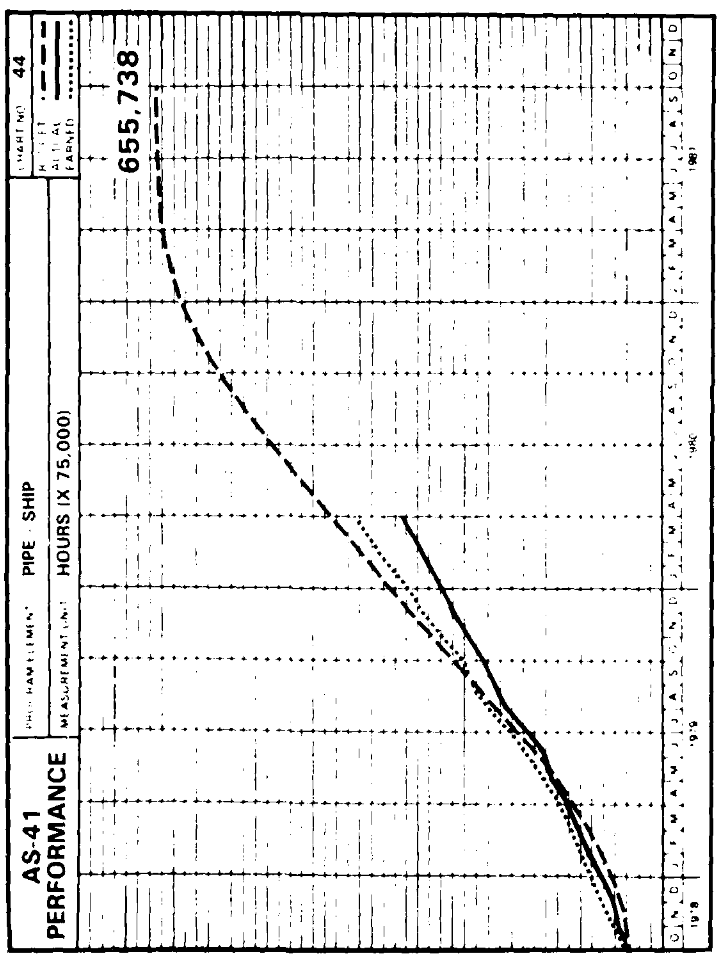


FIGURE 13
Labor Progress Plot

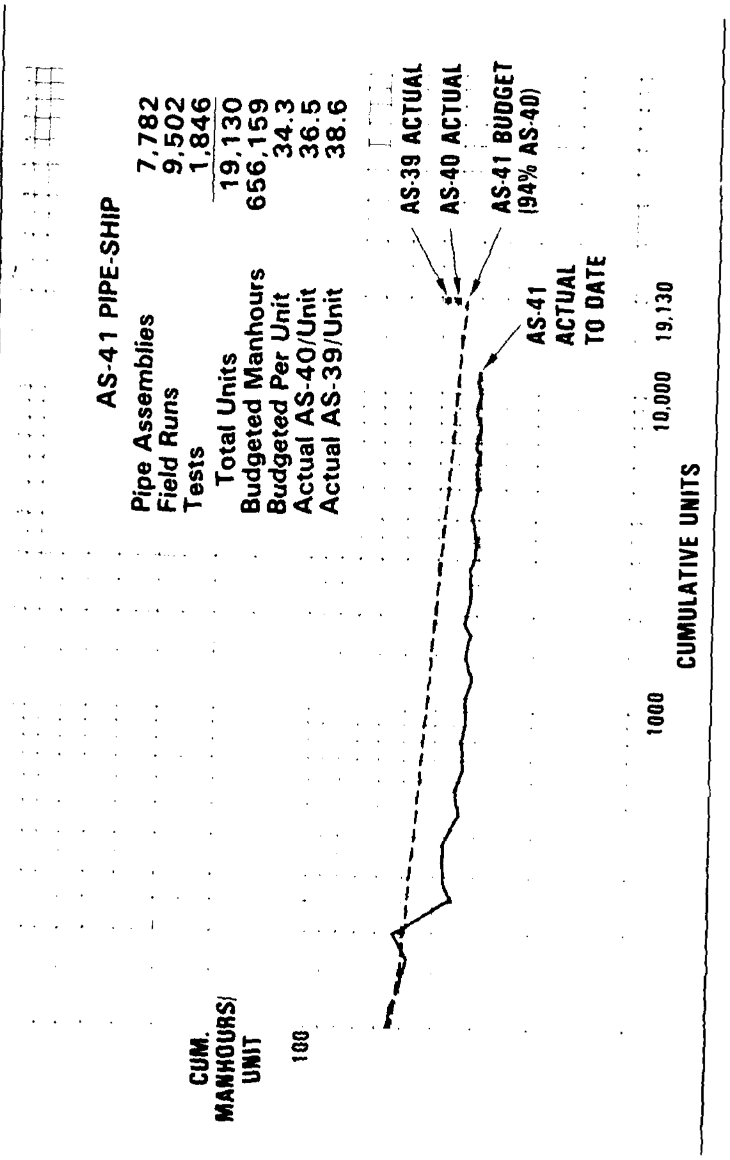


FIGURE 14

Objective Attainment

<table>
<tr><td>PERFORMANCE
VISIBILITY</td><td>• High Visibility
• Identical Numbers To All Management Levels
• Weekly Reports – 3 M Days After Week Close</td></tr>
<tr><td>FOCUS FOR COMPARING
CURRENT & PROJECTED
WITH BASELINE</td><td>• Baseline Is Control Reference
• Identical Comparison Units
• Cost/Schedule Status & Progress In Common Terms</td></tr>
<tr><td>ACCURATE AND TIMELY
FORECASTS</td><td>• EAC Labor Hours Weekly - All Elements
• Material & Overhead Monthly - Program
• Estimated Forecast Accuracy
<table><tr><th>AT COMPLETION % OF</th><th>LEAD SHIP</th><th>FOLLOW SHIPS</th></tr><tr><td>25</td><td>± 10%</td><td>± 3%</td></tr><tr><td>50</td><td>± 5%</td><td>± 2%</td></tr><tr><td>75</td><td>± 2%</td><td>± 1%</td></tr></table></td></tr>
</table>

The Role of Commercial Products in Systems Acquisition

36

Colonel Raymond W. Reig, USAFR

The acquisition and distribution of commercial products (ADCP) is a much-discussed subject. There is a tendency to call it a new policy; however, with its genesis dating back to 1972, it is more appropriate to call it a policy in search of implementation. This paper will first review the beginnings of ADCP and then suggest some answers to the question, "How and when do we incorporate it?"

In the latter part of the 1960s an uncertainty in the efficiency of government procurement led to the creation of the Commission on Government Procurement. Its charter was to promote the economy, efficiency, and effectiveness of procurement by the federal government. After 3 years, the commission published its milestone report containing 149 recommendations that touched on institutional as well as immediate aspects of existing procurement procedures. Some recommendations leading directly to an ADCP policy included relying on private enterprise for goods and services; stating program needs and goals independent of any system product; creating alternate system candidates; limiting new development of specifications for commercial type products; and achieving greater economy in procurement, storage, and distribution of commercial products.[1]

The major institutional change recommended was the creation of the Office of Federal Procurement Policy (OFPP) within the Office of Management and Budget. As might be expected, this group became the government focal point to address systematic changes to federal procurement practices, and the source of policy guidance for use by federal agencies, although each maintained the traditional degree of management prerogatives. In addition to reviewing overall procurement practices, OFPP clearly defined ADCP policy objectives in a series of memoranda issued in 1976. It said, "Agencies shall purchase commercial products and use commercial distribution systems whenever such products or distribution systems adequately satisfy the government's needs."[2] In the same period, OMB issued Circular A-109, the basic policy reference for acquisition of major systems. In A-109, ADCP is included only by reference to policy established for reliance on private industry within OMB Circular No. A-76.[3] The latest version of A-76 restates basic policy, provides guidance on how to conduct comparative cost estimates, and lists examples of commercial and industrial activities. This listing

1. *Report to the Commission on Government Procurement* Volume 1, Appendix H, Recommendations, December 1972.
2. *A Guide for the Acquisition and Distribution of Commercial Products* Office of Federal Procurement Policy Pamphlet (Draft), April 1980, p. 2.
3. OMB Circular A-109, 5 April, 1976, p. 4.

Colonel Raymond W. Reig, USAFR is the Mobilization Augmentee to the DCS Manpower and Personnel, Headquarters Air Force Systems Command. This article was written as part of the Reserve Utilization Program conducted by the Defense Systems Management College. Colonel Reig holds a B.S. degree in general engineering from the U.S. Naval Academy, an M.S. degree in industrial engineering from New York University, and a master of public administration degree from Auburn University.

contains, at least generically, many activities that are subsystems and equipments in major systems, and gives a clue to the extent and pervasiveness ADCP should have on future systems acquisition.

OMB Circular A-109 fathered Department of Defense Directive 5000.1 and DOD Instruction 5000.2, which are policy and procedural directives on how acquisition is to be accomplished in the Department of Defense. The original issues of 1977 were revised in March 1980; however, in both the original and revised versions, there is a very tenuous link between ADCP policy and the basic documents guiding systems development and acquisition.

This void in guidance was closed September 1978 with the issuance of DOD Directive 5000.37, "Acquisition and Distribution of Commercial Products." The directive contains definitions, objectives, and policy in concise terms. It assigns responsibility for acquisition aspects of ADCP to the Under Secretary of Defense for Research and Engineering, and the responsibility for logistics aspects to the Assistant Secretary of Defense (Manpower, Reserve Affairs and Logistics).[4] In 1981, comments on the draft version of Part 10, "Specifications, Standards and Other Product Descriptions," and Part 11, "Acquisition and Distribution of Commercial Products," are due back at OFPP. Soon thereafter, OFPP plans to release a policy letter, the essence of which will become Parts 10 and 11 of the new Federal Acquisition Regulation.

The basic thrust of the ADCP policy is to: "(1) take advantage of the innovation and efficiencies of the commercial marketplace, (2) avoid the development of duplicative Government products when adequate commercial products are available, and (3) prevent overlapping government systems for distribution of products when there are adequate commercial distribution channels. . . . [ADCP policy] emphasizes the Government should be able to use commercial products in the same manner as other institutional and industrial consumers. Where commercial distribution channels are available . . . commercial products should be purchased for direct delivery. . . ."[5]

How

The "how to" of ADCP policy is best contained in an 11 October 1979 memorandum from the Deputy Under Secretary of Defense to the Assistant Secretaries of the Army, Navy, and Air Force. This memo transmits a draft orientation/training plan which splits all government acquisition into four categories, previews future guidance being developed, and relates required ADCP actions to specific steps in the existing acquisition procedures.[6]

4. DOD Directive 5000.37. "Acquisition and Distribution of Commercial Products" 29 September 1978.

5. *A Guide for the Acquisition and Distribution of Commercial Products*, (Draft) April 1980, p. 4.

6. Dale W. Church, *Training in Federal Policy on Acquisition and Distribution of Commercial Products (ADCP)*, (DOD Directive 5000.37), ODUSD (Acquisition Policy) memo, 11 October 1979

Government requirements for supplies and services spread across the spectrum from rubber bands to radio telescopes, from shoes to ships, and on and on. Different people, procedures, and organizations acquire goods and services that differ in value, use, and support requirements. It is apparent that a single ADCP procedure cannot effectively pertain to all government acquisitions. A required first step, accomplished in the orientation/training plan, is to segregate procurements into the categories listed below:

1. *Major Systems—New Development:* Major acquisitions procured under DODD 5000.1 and DODI 5000.2; that is, major systems developed and procured through a program management office.

2. *Major Systems—Commercial:* Major systems which have been commercially developed, but which can be modified to accomplish a military or other government mission. Acquisition of systems in this category will also use a program management office and 5000.1 and 5000.2 procedures.

3. *Less-Than-Major-Systems and Reparables:* Subsystems and equipments acquired under a different management structure than that used for major systems. Program offices are normally not involved, but material, commodity, and equipment managers are.

4. *Consumables and Non-Reparables:* Purchase of parts, supplies, and other consumables that do not require repair or maintenance. Typically, these are high-volume, low-value goods.

From this point on, we will concentrate on the ADCP aspects of only the first category, major systems—new development. Some comments regarding how acquisition and distribution of commercial products will affect acquisition procedures for the other three categories will be made later.

The 11 October 1979 memo states that "DSMC [Defense Systems Management College] will remain oriented on new development programs under A-109, and those major systems that may be predominantly commercial but acquired under a project manager structure. The intent is for DSMC to provide DOD-level training guidelines and experience while organizational details and implementation remain tailored to the needs of the services and DLA [Defense Logistics Agency]."[7]

As mentioned previously, efforts have long been under way to change and consolidate existing acquisition regulations for many reasons, one being to facilitate acquisition and distribution of commercial products. The draft operational concept that will appear in the Federal Acquisition Regulation, Part 11, to accomplish this is as follows:

—Market research and analysis will be used to ascertain product availability, business practices, distribution, support systems, and any other information required to determine ability of the marketplace to fill the need.

7. *Ibid,* p. 1.

—When needs can be satisfied by commercial products, an acquisition strategy will be designed to solicit offers from a wide range of suppliers on terms comparable to those established in marketplace competition.
—Distribution and logistics support will be a part of the strategy on a "least-total-cost" basis.
—Method of solicitation, type of contract, product description, and evaluation criteria will be designed to carry out the strategy as economically and effectively as possible.

This proposed concept differs significantly from current practices in that both the acquisition strategy and solicitation documents, including the purchase description, are based on realities of the marketplace rather than ". . . on a detailed specification that may not fit the marketplace."[8] Additional "how to" instructions on achieving these Federal Acquisition Regulation objectives will be contained in the DOD Manual on ADCP.

The orientation/training plan goes on to list chronological milestones in the *major systems acquisition* process and indicate some ADCP implementation considerations for each. We will use this approach. Before we do, however, it is very *important to clearly understand* that the departure point for introducing ADCP into government acquisition, at least in category 1, is the existing procedures, DOD documents 5000.1 and 5000.2. Also, it is clear that ADCP changes this baseline by introducing a totally new function, market research and analysis, and by requiring decisions which could replace entire sections of the existing procedures for major systems acquisition.

The market research and analysis (MR&A) function will determine the success or failure of the ADCP policy. It's *that* important. Market research and analysis consists of two types: One surveys the state-of-the-art using high-technology point contracts, technical societies, and professional associations aware of new *developments in a specific field*. The other type of MR&A is a search for sources offering commercial equipment that would meet a current DOD need.[9] For major systems *requiring new '. lopment*, an early responsibility of the program manager is to be aware of ADCP policy, to know who in his support structure is responsible for ADCP *market research and analysis, and* to plan for ADCP consideration starting with the mission element need statement. He should also make MR&A a special task for his *system integration contractor. In major systems* development, ADCP will most probably appear at the subsystem or equipment level, but the program manager must develop a systems design that will allow for this lower level incorporation now or later.

---

8. *Ibid*. memo attachment, p. 3.
9. *Commercial By Design. Proceedings of the Workshop on Commercial Commodity Acquisition*, 17-19 January 1978, DOD and NBS. Document AD AO52922. p. 15.

The second major point to be understood about ADCP is that it may be applied *in lieu* of entire sub-procedures. This will create a number of decision points as a system develops where old or new procedures must be selected. For any specific item of equipment, ADCP policy does not allow old procedures and new ADCP procedures to be used. Over the past 30 years, personnel involved in systems development and acquisition have been educated and experienced in a procurement methodology now codified in OMB Circular A-109 and DODD 5000.1 and DODI 5000.2. To successfully implement ADCP we must now use these documents, yet be aware that ADCP requires consideration of changes at specific points in the development cycle. We must work from the known to the unknown, seeking transfer of techniques that have proved valuable in the past.

One of the most effective techniques is the retention of competition at the system level for as long as possible. Under this umbrella, the alert program manager can ask for a system design that remains open to ADCP options as long as possible. He can instruct his competing system contractors that "degree of ADCP incorporation" will be a factor in the systems award, and can request special studies on the distribution aspects of system design to maximize commercial participation. While systems competition exists the program manager can acquire important logistics considerations such as quality assurance, warranties, repair, and shipping. However, the *sine qua non* action the PM can take to facilitate using ADCP will be to keep the system design open as long as possible for incorporation of ADCP at lower design levels.

When

Consideration of ADCP policy should begin with the mission element need statement (MENS), which must state the perceived need in functional capabilities required, not system hardware characteristics. This, of course, is conducive to the ADCP requirements. Several constraints such as logistics, manpower, and NATO RSI must be addressed in the MENS. Since these are also ADCP concerns, a brief statement within the MENS should indicate ADCP policy will also be included in the alternative systems studied during the concept exploration phase.

In Phase O, the preliminary design data is basic to other efforts accomplished during this period, such as support considerations, risk assessment, cost estimates, utility analysis, and energy effectiveness.[10] The preliminary design, then, is key to facilitating the acquisition and distribution of commercial products within the new development of major systems. Although ADCP probably will not appear at the system level, the design should allow consideration of ADCP at lower design levels. OMB Circular A-109 restricts (new) development of subsystems until the subsystem is identified as a part of a system candidate for full-scale development. This restriction may allow use of a commercial product

10. AFSCP 800-3. *A Guide for Program Management* 9 April 1976, pp. 2-6.

closest to the subsystem's required functional performance in the preliminary design. Overall error budgets may then be altered as subsystem success and shortfalls are experienced, and it may be possible to retain the commercial product into final design, thus saving development costs and adhering to ADCP policy.

Acquisition of commercial products will greatly affect cost and schedule estimates, production feasibility, and test requirements needed in the concept exploration phase, because estimates of commercial products are usually more known than estimates of paper designs. Use of commercial distribution in the program design will have the same beneficial results in the logistic estimates for much the same reasons. Formal trade studies will, however, determine if commercial products acquisition and distribution has a place within the system being developed. In any event ADCP should be squarely addressed in this phase. The chances are good that if the preliminary design was sensitive to ADCP and a good market research and analysis function was used, ADCP considerations will be a part of the acquisition approach selected.

The documentation required for a decision to proceed beyond concept exploration provides the next opportunity to include ADCP policy into a major system—new development. Both the decision coordinating paper (DCP) and the integrated program summary allow several entry ports for ADCP. The DCP is a program summary used by Defense Systems Acquisition Review Council (DSARC) members and includes the acquisition strategy. The acquisition strategy consists of the degree of competition, the tailoring of procedures planned, and the program alternatives considered.

The integrated program summary expands greatly on the DCP and includes such ADCP sensitive functions as:

—*Program Alternatives.* Describe.

—*Cost Effectiveness Analysis.* Summarize assumptions, methodology and results.

—*Overview of Acquisition Strategy.* Describe overall strategy to acquire and deploy the system. Discuss deviations from the acquisition process of 5000.1.

—*Contracting.* Discuss maintenance of competition and plans for competitive breakout of components, contract plans as to type, workscope, sources solicited and selected, special conditions, data rights, warranties.

—*Manufacturing and Production.* Controlled using only DODD 5000.1 and DODD 5000.34 or including the ADCP policy contained in DODD 5000.37? You can't use both for the same equipment.

—*Data Management.* What requirements will be imposed? How much tailoring is desired? The degree of configuration management. Interface identification and control.

—*Test and Evaluation.* Test results to date and future test objectives. Describe overall test strategy. Commercial products may be sufficiently tested already.

—*Cost.* Life-cycle cost estimates, assumptions. Cost controls. Cost visibility.

—*Production.* DOD or marketplace controls.

—*Logistics*. Identify mission requirements that impact system design and support concepts. Identify subsystems and equipments common to other programs. Define support concept alternatives and levels of maintenance. Commercial distribution has a large impact here.
—*Reliability and Maintainability*. Design estimates or experience with similar equipments.
—*Quality*. Summarize the independent quality assessments required. Estimated or comparative.
—*Manpower*. Identify innovative concepts to be analyzed such as new maintenance concepts and organization.
—*Training*. Any significant differences in the training implications of alternative systems considered.[11]

In the concept exploration phase of a new development major system, ADCP probably will not reflect itself in a major way within the system development plans, but it is vital in complying with ADCP policy that it not be excluded from consideration in the later development phases. The key to accomplishing this ADCP awareness by the program office is an "open" system design, and reflection of the open design in the associated acquisition and logistics strategy.

One showcase example of ADCP policy incorporated within a major development program may be emerging in the MX system. Here, it is my understanding the MX program office is funding and working with the Department of Energy to incorporate commercial advanced technology solar energy systems as part of the facility power subsystems. From this "toehold" concept, a number of innovative goals may be accomplished. First, MX will be a large-scale demonstration project to accelerate the widespread use of this emerging technology. Second, it shows reliance on DOE rather than having DOD duplicate technology efforts in this area. Third, it is an ideal situation for total application of acquisition and distribution (including maintenance) of commercial products. Think of the savings, not primarily in dollars but in scarce manpower and facilities, if the Air Force does not seek a blue-suit capability to train personnel to stock, repair, distribute, and maintain passive solar systems. Lastly, this is a good example of ADCP use on a first-line combat system, the category of systems usually automatically excluded from ADCP considerations.

Iterations

A main characteristic of the major systems acquisition procedures stipulated in DODD 5000.1 and DODI 5000.2 is the iteration of management attention through a dozen or so system development considerations. All, to the degree possible, are addressed in the very earliest system development phase discussed above. Each is revisited as the design and system develops, and necessary detail-

11. DOD Instruction 5000.2, "Major Systems Acquisition Procedures," 19 March 1980.

ing is accomplished in each area as soon as it is possible to do so. One of the major purposes of DSARC milestone reviews is to assure that at least the planning for each area has been accomplished. The planning for consideration of acquisition and distribution of commercial products within the system is one area that should be included in this iteration and detailing. What follows is a review of selected requirements of the development phases, and the milestone decision points, to identify ADCP implementation opportunities.

Acquisition strategy is an overall consideration of the program manager. From the very beginning, sufficient forward planning must be accomplished so that considerations having a direct influence on competition and design efforts by contractors in subsequent program phases are encouraged. This has been our ADCP message to this point. The life-cycle cost estimate will be updated. Cost, schedule, performance, and supportability goals shall be documented, and at Milestone II system design-to-cost goals shall be established. DODI 5000.2 requires cost, schedule, and supportability goals be evaluated with the same rigor as systems technical performance. Competitive concept development encourages all possible acquisition and support alternatives to be considered. Detail specifications should be avoided, when possible. The number of government specifications used should be minimized, and solicitations should normally not specify standard support concepts. Contracting techniques should introduce and maintain competition throughout the acquisition cycle as long as economically practical. The government and contractors shall break out components for competition throughout the acquisition cycle to the maximum extent possible. Production planning shall consider means to increase the possibilities for competition during production. These directions all facilitate consideration of ADCP.

The operational concept provides the basis for integrated logistics support (ILS) planning, and must be finalized by Milestone II. Because ILS has so many ADCP considerations, the operational concept becomes a key to incorporating ADCP and should be approached with this viewpoint. New systems shall be designed to minimize both the numbers and the skill requirements of people needed for operation and support, with manpower requirements subject to trade-offs with system characteristics and support concepts. Manpower goals, maintenance demands, and support concepts shall be identified during the demonstration and validation phase.

A quality program shall be implemented to ensure user satisfaction, mission and operational effectiveness, and conformance to special requirements. Reliability and maintainability goals will be proposed at Milestone II and shall be the minimum operational values acceptable to the DOD component. Before Milestone III, these goals must be achieved. The considerations of quality, reliability, and maintainability have a special relationship to ADCP since the approach to their attainment and safeguards available to the customer may be entirely different when using ADCP acquisition procedures.

Test and evaluation shall result in an estimate of operational effectiveness and operational suitability including logistic supportability. This estimate shall be available before Milestone III. Integrated logistic support plans and programs shall consider innovative manpower and support concepts. Alternative maintenance concepts shall be assessed during concept development and other appropriate points of the life cycle. Detailed support planning shall be initiated during full-scale development. Before Milestone III, the fully developed follow-on support plans shall be reflected in the overall system acquisition strategy. Thus, throughout the iterative process of system development, ample opportunities exist to consider ADCP, provided the generalist and specialists involved are aware of policy objectives.

Other Considerations

This paper has discussed ADCP in relation to major systems—new development. Some may argue that ADCP is fine for the other three acquisition categories, but not for this one. I disagree. Applying ADCP policy to major systems simply means, at a minimum, keeping options open so commercial acquisition and possibly commercial distribution can be incorporated later at the subsystem level. It then becomes meaningless to differentiate between a commercial equipment selected for a new-development major system and the same equipment selected for a less-than-major system. Although a few striking examples of ADCP used in major systems acquisition can be identified, there is no question that the bread-and-butter applications will be made in the other two categories.

It probably is more useful to consider *who* acquires and by which means rather than *what* is acquired. A program office acquires major systems. Commodity, material, and product managers acquire less-than-major systems and consumables. There is no reason for these individuals to wait for ADCP to trickle down to them in the form of new-development subsystem requirements. Rather, their acquisition activity should reach up with advanced commercial equipment suitable for new systems applications.

I believe government product and commodity managers, and prime systems contractors, are in the best position to perform the market research and analysis required to successfully use ADCP. Market research and analysis consists of knowing or determining what commercial products are available, determining if such products have an established market acceptability, and if commercial distribution channels exist to satisfactorily supply these products to government users. This is specialized knowledge usually available only to those with extensive experience in one commodity area. Prime systems contractors have developed this information for their own business uses, and the program office should direct their primes to take a lead responsibility for systems-level ADCP. For the most part, however, government market research and analysis knowledge resides not with the developers, but with the logisticians. Program offices should rely on their product and logistical functional support organizations.

Determining market acceptability is a major decision that will determine whether traditional system development safeguards, (design specs, standards, test requirements, etc.) are used, or are waived in favor of marketplace safeguards. To date, only a general standard exists to define marketplace safeguards. To be market acceptable, a product must be marketed in substantial quantities to the general public. The implied safeguard here is that no product can survive and continue to be marketed over a reasonable period if it is unsatisfactory. Substantial quantities are defined to mean that sales to the general public must predominate over sales to the government.

These definitions could be troublesome to manufacturers of new-technology products such as passive solar energy units, or to manufacturers who have established commercial-type products "built to print" against a government item description. This was identified as an early concern, and perhaps because of that, DOD Directive 5000.37 states if the products were previously defined by a government specification, and were acceptable, they may be considered under solicitations requiring a product to have established commercial market acceptability. This provision eliminates the potential inability to compete for the two products used in the example above, and also provides for competition in price and design by other products that qualify by having market acceptability.

One concept useful in introducing ADCP into system designs may be "fencing." By this I mean the incorporation of a commercially acquired equipment within a subsystem acquired by traditional system acquisition procedures. The subsystem is undoubtedly covered by maintainability and reliability standards. A failure of the commercial equipment could be used as a reason for voiding the subsystem reliability requirements. Since the required failure analysis should easily determine if the commercial equipment was the failure cause, a "fence," or exception to the subsystem reliability requirements, could be incorporated into the contract. Conceptually, a subsystem could begin with total reliability coverage, and as the system matured, a series of commercial equipments could be introduced, each with its own fence excluding the prime from fault if that equipment or component fails. In this manner the benefits of system warranties are preserved, and the commercial guarantees provided with each equipment can be exercised.

One picture is worth a thousand words. In the same vein, sometimes a case study is invaluable in providing a practical example. I have found a brochure that contains clear and concise statements of experience to date on 11 commercial equipment acquisitions. In each case, user requirements, market research, acquisition strategy, logistics support, and an evaluation are reviewed. Some case extracts quoted from the brochure are:

> —ARN-123 VOR/ILS. Thus at about one-half the price of the predecessor avionics a modern state-of-the-art airborne navigation receiver was procured at a savings of . . . $1,500 each. . . . If a

> militarized set were required . . . it would have tripled the cost and extended (delivery) for approximately 2 years.
> —Diesel Powered Ground Generators. Mil-Std item cost $56,000. Commercial item cost $18,500. Fuel consumption per hour, Mil-Std 33 gals, Commercial 25.9 gals.
> —LTN-72 Inertial Navigation System. The (commercial) acquisition of the LTN-72 provided an opportunity to learn more about fielding systems without rigid configuration controls. . . . Seemingly this absence would relinquish government contol on system reliability. . . . Nevertheless, the LTN-72 system has amply demonstrated sound performance.[12]

No article would be complete without its caveat. Ours is this: We have cut a broad path through major systems acquisition discussing ADCP impact on system design, trade studies, cost studies, acquisition functions, and considerations such as production, manufacturing data, test, reliability, quality, training, and maintenance. In each area we have commented on changes required to incorporate ADCP policy. We were writing for, and from, the viewpoint of a systems engineer. Any serious consideration of ADCP in any of the areas covered must include consultation and assistance from the functional specialist.

Conclusions

The methodology for acquiring and developing DOD weapons systems has evolved over a 30-year period. Changes have been evolutionary. What worked well was retained, and changes in program planning techniques were largely additive. Practitioners of the art adapted to these changes easily since none required drastic re-education.

The acquisition and distribution of commercial products is different. For it to work effectively and to any large degree, many comfortable acquisition practices must be halted and replaced with new concepts foreign to the systems engineer and the program manager. They must come out from behind the protection of overdesign and the wall of specifications included in the typical DOD contract. Worse yet, this security is to be replaced by adherence to something called "the test of the marketplace" determined by personnel outside the program office and usually at the subsystem and equipment level.

The reluctant system developers' only hope of not undergoing extensive relearning is that the ADCP policy will go away. My reading of the tea leaves indicates it will not. The elephant has gotten its trunk under the tent, and too much evidence of the worth and benefits of ADCP have been uncovered not to go unnoticed or to turn back.

12. Office of the Under Secretary of Defense, Research and Engineering, Brochure "Case Studies on Commercial Commodity Acquisition Program," 19 December 1977

47

Translating ECPs into Budgeting Form

Major Lawrence L. Vandiford, USAF

One of the most significant challenges faced by a program manager is that of ensuring that sufficient funding is available to accommodate engineering change proposals (ECPs) throughout the acquisition phase of a system's life cycle. The purpose of this paper is to identify, discuss, and relate some viable philosophies, approaches, and alternatives to this challenge in the interest of pointing out that budgeting for ECPs need not rely on guesswork. The ideas presented are based largely upon my own experiences in several Air Force Program Offices over the past 11 years. A minimal familiarity with the fundamentals of configuration management is assumed; those aspects touched upon have become largely standardized within DOD and should not be novel to any service reader.

The Nature of ECPs

The term "ECP" is defined in DOD-STD-480A as "both a proposed engineering change and the documentation by which the change is described and suggested." It represents a proposed alteration to the configuration of a configuration item (CI), which may be a piece of hardware, a computer program, or a system. It can occur anytime in the acquisition phase after specifications have been baselined (approved) and, like all things, costs money. Funds are required to prepare an ECP, to evaluate it, and, finally, to execute it. ECPs are an integral aspect of the system development process and are one of the means by which configuration management controls changes to established baselines. Since ECPs can and have represented a significant element of cost in a program they must be accounted for in the budget and managed and controlled as well. Recognizing this fact, a program manager must devote an appropriate amount of his management attention and resources to change management to anticipate funds requirements in this area.

Management Philosophy

A prerequisite to effective and efficient change management and budgeting is the establishment of a sound management philosophy. Mature program managers recognize the basic necessity of ensuring that technically qualified personnel are included in the program office budget formulation and update activities. Continuous communication between engineering and business management personnel is essential throughout the acquisition phase. This entails joint activity to the extent practicable, including participation at technical and manage-

Major Lawrence L. Vandiford, USAF, is Deputy Program Manager for Integration in the SEEK TALK Program Office, Electronic Systems Division, Hanscom AFB, Mass. He has held engineering, business management, and systems analyst positions in a number of programs including IGLOO WHITE (Sensor Systems), SEEK POINT (VNAF Radar), AWACS, SEEK IGLOO (Alaskan Minimally Attended Radar), and the global positioning system. Major Vandiford holds a B.S.E.E. degree from the University of Massachusetts and is a graduate of DSMC's Program Management Course.

ment reviews as well as collaboration in reviewing monthly cost, schedule, and technical reports from the contractor.

It is also important that the program manager place strong emphasis on change minimization to all personnel—particularly engineers and representatives of the using command. This is intended to minimize the seemingly natural tendency to enhance capabilities by continually improving, modifying, and at times "gold plating" a system. Recognition must, however, be given to the fact that a certain amount of change is to be expected—to correct a technical problem; to accommodate a *validated* change in a user's requirement; to respond to a change of significance in the threat; or to realize some significant cost savings in system acquisition or operation and maintenance.

Perhaps the most significant aspect of a change management philosophy is "avoidance of surprises." Surprises short-circuit any orderly approach to budgeting for changes and can demand funds which have not been programmed and are otherwise unavailable. While eradication of so-called "unknown-unknowns" is never totally possible, it must be an objective.

It has been my experience in both major and non-major programs that establishing and supporting an engineering-business management team is an effective approach for dealing with change budgeting (among other things). This team need not consist of dozens of personnel; as few as two or three have been seen to work quite well. Once specific individuals have been identified, they include the objective of anticipating change funding requirements in their areas of activity, being sure to keep the program manager informed. During the annual POM preparation, their inputs and observations prove invaluable to the program manager.

Sources of Change

Having established a change management philosophy and considered the appropriateness of a joint engineering-business management team, the next logical consideration is that of knowing what the typical sources of change are and their expected timing. The following potential sources of change are not intended to be all inclusive, but have in my experience been noteworthy generators of ECPs.

Formal design reviews, including preliminary design review (PDR), and critical design review (CDR), frequently occasion ECP activity. Contractor trade-offs are presented and usually pose attractive features and avenues to improvement and optimization. Also, government personnel tend at times to covertly or overtly foster change because of increased visibility into design areas of differing interpretations of specification requirements (relative to contractor interpretation). It is essential that program management personnel monitor contractor activity well in advance of formal reviews to avoid surprises. Additionally, pre-review in-house meetings should emphasize to all government attendees the importance of perturbating contractor efforts only when good reason exists. In all cases, the program manager should decide what constitutes a sound basis for change.

Qualification testing, as well as initial operational test and evaluation, can be a source of many ECPs. Testing is the moment of truth for a design; it either passes or fails. Failures warrant corrective action to redesign hardware or restructure software. Care should be taken to ascertain that ECP fixes are cost effective and will not lead to the requirement later on for more costly ECPs. So-called "no-cost" ECPs for compatibility changes are not really no cost. They take time and money to prepare, review, and execute and can translate into overruns in cost contracts or fixed-price-incentive arrangements.

User "druthers" represent another source of ECPs. Frequent changes in user command personnel may often lead to changes in perception of what the operational requirements really are and lead to attempted specification changes. It is essential that the user personnel be closely linked to the program manager's change management philosophy and be sensitive to funding considerations. I have seen user personnel attempt to flood the contractor and the program office with additional, *unvalidated* requirements that in some cases have contributed to serious funds problems. On the other hand, one user representative initiated ECP action which, for $20,000, is expected to save the Air Force over $400,000 per year in model rental and long-haul communication line rental. This action was handled through the program office and acclaimed by all as a model as to how things should be done. In the case of unvalidated user requirements, these should be emphatically rejected by the program manager and forwarded by the user through the appropriate headquarters for validation and funding. Only in this way can funding requirements be reasonably responded to in the context of the user's preferences.

Technology changes can be expected in today's environment and should be monitored for consideration by the program manager. It would be foolhardy to overlook incorporation of new technology (provided risks are manageable) and field obsolete systems. In any event, costing should consider an orderly approach to phase-in of new technology, provided POM inputs are favorably received. In the case of technology upgrades, ECPs should be scrutinized to ensure that more than the "tip of the iceberg" has been disclosed.

Threat updates are typically accomplished annually and require review for possible changes in requirements. When significant changes occur, POM updates should address funding for baseline changes over which the program manager has little control.

Associate contractors can at times contribute as an ECP source, particularly with respect to government-furnished equipment (GFE), and other interfaces. When expected physical and functional characteristics of GFE and/or system interfaces are changed, system design is affected. Good configuration management practices warrant the establishment of interface control working groups

(ICWGs), and the preparation of formalized interface control drawings. This helps to ensure that unilateral actions by associate or prime contractors do not give rise to costly ECPs. Additionally, regularly scheduled ICWGs help to guard against delayed notification with regard to contemplated (proposed) changes and tend to support funding forecasts.

Requirement changes in specified environments can represent a virtual unknown. Aspects such as thermal environment, shock, humidity, space particle density, etc., can decrease, but frequently do the opposite, giving rise to costly ECPs. It is essential that basic specifications be as complete and realistic as possible to avoid costly changes. This is not always possible, however, as in the case of one space vehicle contract awarded in 1974, which had to update electron environments in space based upon 1976 satellite measurements with an increase of several orders of magnitude in expected environments. The consequence was a costly ECP for added satellite shielding, the funding of which was most problematical.

Managing/Budgeting for Changes

Initial budget submissions must of necessity rely on gross estimates derived from experience, as well as similar and/or related programs. Typical factors vary; however, 15–25 percent coverage in management reserve is not uncommon. This reserve should be explicitly stated or distributed across cost estimates. Once the initial factor for changes is estimated, it should be continually assessed by the engineering-business management team based upon diligent monitoring of the expected sources of change. Revisions to change funding should consider the cardinal principle of credibility in funding estimates; forecasting what is needed each year must be balanced against the ability of the program office to use the funds (obligate/expend). There exists identifiable management actions which represent controls (if not safeguards) on ECP activity and associated funding requirements/obligations/expenditures.

The advanced change study notice (ACSN) is a contractual vehicle whereby a data item is levied on the contract data requirements list (CDRL) to control contractor ECP action. It requires the submission and approval of a one-page summary identifying and justifying contemplated ECPs. This serves to control so-called "get-well" ECPs and ensures government visibility. It precludes resource expenditure in the sometimes costly area of ECP preparation.

The program office should ensure that the basic system design includes sufficient margin to support some reasonable amount of growth. Such areas as power, weight, space, cooling, and use of modularity are items to be considered. This will help to minimize the extent of redesign required to accommodate needed changes and thus reduce ECP costs.

Provisions exist within MIL-STD-481A for converting ECPs into waivers and deviations and thus avoid unnecessary costs. This should be judiciously applied, however, on a case-by-case basis considering performance effects and safety considerations. Deviations constitute one-time relief owing to process or material shortcomings; waivers constitute a decision to accept a system even though all specification requirements have not been met. These are basically judgment calls and should be closely coordinated with the system user.

Management emphasis should be placed on timely preparation and submittal of ECPs as well as timely review action by the government. Unfortunately, this is a universal problem area wherein from the time of submission to contractual application as much as a year (or more) can elapse. These delays can frequently jeopardize funds obligation and increase costs owing to inflation and lack of restraint on contractors in accomplishing undefinitized work. This can be a particular problem in joint programs (multiservice) where ECP approval loops are complex. Attempts should be made to streamline approval cycles as much as possible.

DOD-STD-480A requires that all submitted ECPs be completely analyzed for all effects. This effort should be intensive and completed in as reasonable a time as possible. The extensive ECP Form 1692 formats afford an opportunity for identifying all affected areas, including hardware, software, support equipment, technical orders, spare parts, and specifications. It is essential that complete review take place to be certain more than the "tip of the iceberg" has been disclosed. It is also essential that the cost of the ECP be tied to a specific execution schedule which integrates development, production, and kit installation.

Upon approval, diligent surveillance and management are essential to ensure that the planned integration of development, production, and kit installation does not deviate from budget plans. Any disconnects can result in cost growth and loss of funds if obligations and expenditures are not realized per plan. Planning should specifically address total procurement vs. incremental funding, depending upon the budgetary climate. In any event, planning should be flexible, given the uncertainties in budget approvals and delays sometimes experienced between development and production.

Conclusions

Translating ECPs into budget form is a dynamic and continuous process within the program office. It must be based upon a sound management philosophy of minimizing changes, relying on technically qualified personnel, participating with business management personnel in budget formulation and updating, and diligently monitoring sources of changes. Upon timely approval of necessary changes, their execution must be carefully planned and monitored to ensure that budget disconnect does not occur. While ECPs represent a worthwhile and desirable change control in system development, they must in turn be controlled and communicated to the budgeting process on a timely basis.

53

Simulation in Training: The Current Imperative

Lieutenant Colonel Richard P. Diehl, USA

The U.S. Army can no longer afford to train its forces as it has in the past. Equipment and petroleum products are becoming inordinately expensive. Today's munitions (and laser range finders), in addition to being costly, have such extended ranges that many of the range complexes that were sufficient in the past are no longer adequate—and there is no room to expand them. Mechanization and the fluid tactics it allows has extended the breadth of tactical operations such that training areas that once were big enough for large field maneuvers are now confining.

Our European allies have been faced with similar problems for decades. Their limited military budgets have not permitted them to have a "steel on target" philosophy of training. Further, their civilian populace has demanded that scarce land be devoted to production rather than military readiness. The Europeans have long embraced simulation as an alternative. As a result, European industries are ahead of their U.S. counterparts in developmental research and marketable training support products—and unless there are changes in the way the U.S. Army develops simulators, that comparative advantage will remain.

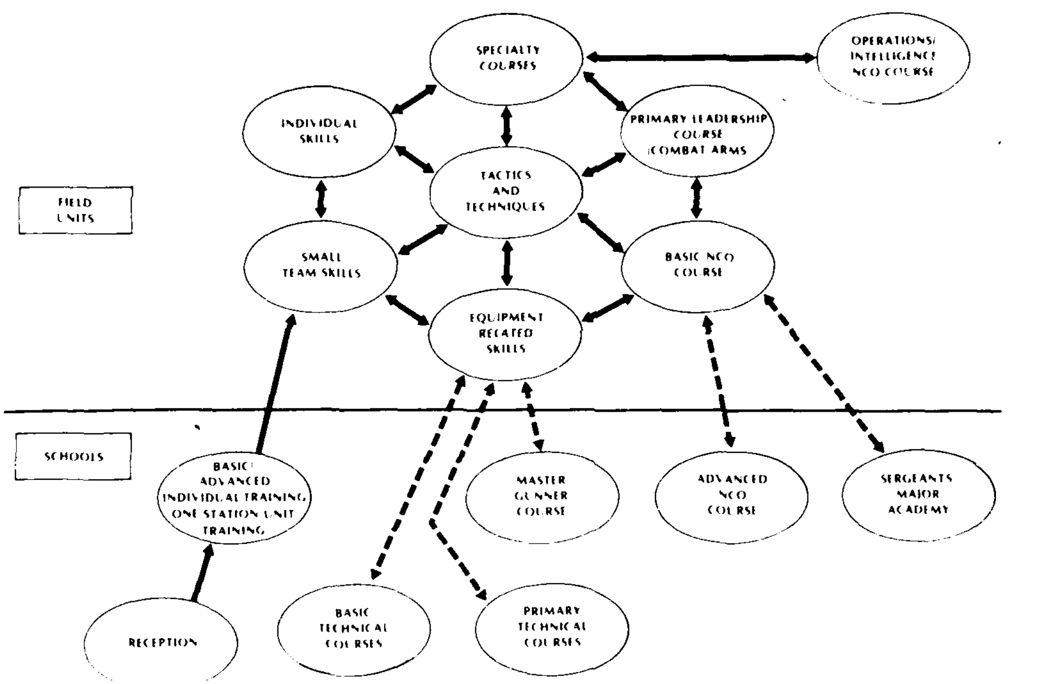
Before we consider the shortcomings in the U.S. system for developing training simulators, (the terms "simulators" and "devices" will be used interchangeably) we must understand the training system they are designed to support. This is important also in that Department of the Army Pamphlet 310-12, the catalog of Army training devices, is full of simulators that have been developed in the past. This would appear to be a contradiction; yet, as you will soon see, it is not.

The U.S. Army—and for that matter the armies of our allies—has a training system that essentially follows the pattern in Figure 1. Note that as the individual enters the Army he is sent to a branch-related school for basic and advanced individual training. The length of time spent in school varies with the specialty, but for those specialties of interest to us here—maneuver and fire support, i.e., armor, infantry, and artillery—that time is 12 weeks. This preliminary training teaches basic soldier skills, weapons firing, and some of the critical skills the soldier will need to perform his combat job at a basic skill level. From the school the soldier is assigned to a field unit. This is where the preponderance of his training actually takes place. Should the soldier stay in the Army, he may later return to the school system for brief professional development courses, but those occur after many years are spent in field units learning the rudiments of his vocation.

There is a dichotomy in the way simulators have traditionally fit into this training system. Although most training occurs in the field, most of the

Lieutenent Colonel Richard P. Diehl, USA, is Manager, Second-Source Production Office of the Program Manager, Fighting Vehicle Systems. He was previously Program Coordinator in that office. In addition to numerous infantry assignments, Colonel Diehl served as Chief of the Requirements Branch in the Army's Training Device Requirements Office. He holds a B.S. degree in mechanical engineering from the University of Michigan, and an M.B.A. degree from Tulane University.

FIGURE 1
Pattern of U.S. Army Training System



simulators in the inventory are in the schools. The reason for this is that schools have been subject to severe budgetary constraints, personnel restrictions, intense scrutiny of "student instructor" ratios, and limitations on the amount of actual equipment available for training. In addition, because of the functional consolidation that occurred with the formation of the U.S. Army Training and Doctrine Command (TRADOC) in 1973, schools have been assigned numerous non-instruction responsibilities—training extension courses, training device requirements development, user representation, field manual development, combat developments, correspondence courses—that draw resources away from platform instruction. In that environment, simulation has been valuable; generally, these are the simulators to be found in DA Pamphlet 310-12.

In the field, the thinking has traditionally been: "We have the equipment; why not use that equipment to train?" This has been reasonable, given that there has been sufficient ammunition and fuel, enough operating funds to pay for the repair parts required as the equipment broke in use, and enough space to employ the equipment as it would be in combat. Unfortunately, this is no longer the case. For example, there has been startling cost growth in various categories of ammunition, while the ammunition budget, in constant dollars, is actually decreasing. Thus, one can readily discern the cost budget pinch confronting field trainers.

The same kind of cost growth is evident in various equipment classes in the decade of the seventies, the M60A1 tank increased in price by over 325 percent; the M113A1 armored personnel carrier by almost 320 percent; and the M109A1 howitzer by over 460 percent. As new systems emerge, the prices go up drastically; the procurement costs of the XM1 tank ($1.1 million) and XM2 3 fighting vehicles ($600,000) illustrate this. These cost escalations make a field training strategy that relies on using major items of equipment questionable today and probably impossible in the future.

The cost problem extends to repair parts as well. Figure 2 shows the current costs of various components that are habitually broken in field training. The total cost for replacement items like these Army-wide is over $11 million yearly. That figure represents not only normal malfunction, but also the effect of soldier breakage through mishandling as he learns about the equipment through "hands-on, trial and error."

The soaring costs of fuel and other petroleum products are evident to everyone. This has an immense impact on training in the field. Figure 3 shows the current operating costs per hour for a tank, armored personnel carrier, and howitzer.

There are certain indirect costs as well that inhibit field training. There is only limited space on which to do the training and that limited space must be shared by a great number of units. This is particularly acute in Europe and will become

FIGURE 2
Current Costs of Components Frequently Damaged during Field Training

	System		
Component	**M60A1**	**M113A1**	**M109A1**
Engine	$56,576	$9,041	$11,750
Transfer	2,688	1,440	—
Final Drive	3,611	986	2,000
Transmission	30,349	3,165	28,000
Differential	—	3,960	—

Source: DARCOM Commodity Managers

FIGURE 3
Typical Army Vehicle Operating Costs

Vehicle	Operating Cost/hour
M60A1	$1074
M113A1	264
M109A1	1944

more so when the weapon systems currently in development are fielded. As an example, there will be but one training area (Grafenwoehr) at which the new M1 (Abrahms) tank can be fired. In the United States the situation is not quite that confining; however, the added range safety requirements of the M1 will require safety waivers almost everywhere (with attendant stringent, restrictive rules attached). As an example, Fort Hood, the Army's largest tank-force post, will have sufficient space for but one qualification range for the M1, while today there are three for the M60 series tanks. That situation will be even worse later when the longer-range 120mm smooth-bore gun is incorporated into the M1 tank system.

One of the programs that the Army has started to counter range problems is the National Training Center. This vast facility will be located in the desert at Fort Irwin, Calif., where virtually all battalion and brigade support weapons, current and future, can be accommodated. Projected by 1984 will be a facility that can accommodate up to 42 heavy battalions—maneuver and fire support—per year. At this facility will be the latest in training technology, to include the multiple integrated laser engagement system, a position locating system, and changeable target arrays. Units will arrive at the facility, draw equipment on-site, and train extensively for about 2 weeks. The British and Germans, for their live-firing segment of training, have adopted a similar strategy—at Suffield and Shilo, Canada, respectively—in which units in Europe are moved similarly into equipment for intensive, live-fire field training. This does not solve the cost problems described earlier; in fact, it adds an additional cost factor—transportation to and from the facility. More importantly, and perhaps the most significant detractor, is that a battalion will only be able to undergo training at the facility every 18 months—and the U.S. units in Europe will not be scheduled to use the facility.

In view of these obstacles to effective training, a different approach must be taken. The actual equipment, ammunition, and ranges are not available, so we must simulate them. Support systems must be developed that will allow field units to train individuals, crews, and tactical units at home stations—field units need simulative devices desperately. Yet there are hurdles in the research, development, and acquisition processes that complicate, retard, or totally preclude the adoption of a simulation-based training strategy. Generically, these hurdles could be described as: (1) timeliness of simulator developments; (2) management diversity; (3) funding dilemmas; and (4) logistical support system inadequacies. Let's consider these one at a time.

Timeliness of Simulator Developments

It takes too long to develop and field simulators today. Within the Army's *Catalog of Approved Requirements Documents* there are active training device requirements that were approved for development and procurement as far back as 1972. Most of these systems *still* have not been fielded. One may counter that some of these systems are complex, perhaps state-of-the-art, developments that require long development cycles. Yet, some of these items were, and are, available on the commercial market either from domestic or foreign sources. What causes these delays? The causes vary. The user may want added features not available on the commercial models. These may be "nice-to-have" features, "gold plating" or legitimate, critical features necessary to support the training objectives. Army commodity commands or laboratories may believe they can build a better piece of equipment. Sufficient funds may not have been approved to finance the program. The commercial firms may be small businesses that may not be fully reliable either financially or in production capacity and there are myriad other reasons, each of which puts additional time into the equation.

Whatever the cause, the Army cannot accept these delays and comply with Department of Defense directives and/or Army regulations which require that any system to be fielded must have its total support system—to include the train ing support system, functional when the system is introduced to the field. For the systems already in the field, the user with a critical and immediate training need cannot afford to wait the 7–12 years needed to traverse a normal full hardware development cycle.

The problem of developing training support materials for weapon systems in development is that the characteristics of those materials cannot be identified until the tasks for which training is required have been determined and tested. That testing ideally concludes during the weapon system's developmental operational test II; it may, as with some systems, be even later than that. This means that in order to have a fieldable training simulator by the time the weapon system is deployed, that simulator must squeeze a complete research, development, and acquisition cycle into the time frame alloted to the facilitization, low-rate initial production, and production phases of the supported systems—perhaps 2–3 years.

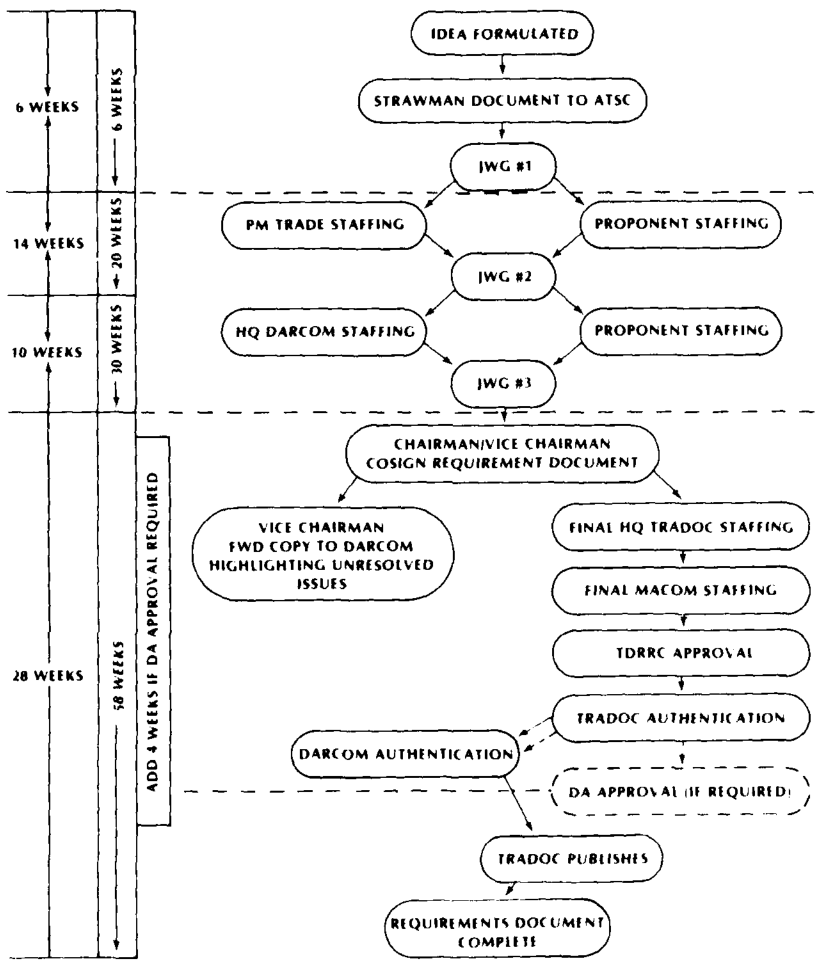
This compression of the research, development, and acquisition cycle has rarely worked well owing to such impediments as requirement staffing delays, a penchant for low-risk development approaches, over-testing, and excessive reliability, availability, and maintainability (RAM) requirements. Shown in Figure 4 is the sequence and associated time required for the U.S. Army Materiel Development and Readiness Command (DARCOM) and TRADOC communities to staff, complete, obtain approval for, and publish a requirements document of some type, be it training device requirement, letter requirement, or training device letter of agreement.

Until this document is complete (and approved at the appropriate level) no money can be applied to the developmental and or acquisition effort. Note the number of participants in the process. Not stated in Figure 4 are the extensive tangential requirements that must accompany the document if it requires Department of the Army approval. In that case, to obtain approval a Basis of Issue Plan (BOIP); Quantitative, Qualitative, Personnel Requirements Inventory (QQPRI) and a preliminary Cost and Training Effectiveness Analysis (CTEA) must be completed and accompany the basic requirements document. That adds to the bureaucratic burden and inherent time delay.

One can readily see a direct parallel to the requirements generation process for a major weapons system. Indeed, research, development, and acquisition (RD&A) of training devices are governed by the same series of Army regulations. However, how can the training device RD&A cycle be compressed into a 2–3-year period when it habitually takes 58 weeks just to obtain approval for the requirements document? It obviously cannot, even if the item is commercially available, given contracting/source selection lead times, testing requirements (even if limited), technical documentation, and logistical system startup.

In developing a major weapon system, managers attempt to minimize risk. This is done in a number of ways, but the formal method is to replicate test sampling sufficiently to develop very high confidence that the system will do what it was designed to do. This same theme carries over to the development of

FIGURE 4
Staffing of an Army Requirement Document



*Provided by Project Manager, Training Devices

training devices. The training device is looked upon as another piece of hardware that must undergo the same developmental/operational testing cycle as a major item of equipment, with some significant differences. The training device does not have to withstand the rigors of combat; thus, hardware testing replications and statistical confidence levels can be reduced. Further, the importance of the testing should be to determine if the device actually supports the training objectives and allows the soldier(s) to attain the standards desired, i.e., effectiveness of transfer of training. RAM testing remains important, but for a different reason — if the device constantly breaks in use, personnel in field units will lose confidence in it.

How can the various delays in simulator development be eliminated? The training device requirement (TDR) approval authority can be decentralized to the TRADOC/DARCOM level, as the letter of agreement (LOA) and letter requirement (LR) systems have done. Like the LOA and LR, Department of the Army could still retain approval authority for device RD&A programs over certain high-dollar thresholds. For the system-related devices, this is simple to implement — the required operational capability (ROC) of the weapon system should give authority to develop training devices as appropriate. Any documentation beyond that should be used to formalize specific device hardware characteristics and required training criteria.

To further reduce the staffing time required, the number of participants should be limited. The importance of the requirements document is to state what the device must do *vis-à-vis* the training function, the hoped-for hardware characteristics, if known; where and how the device will be used; and what type of logistical support the *user* prefers. With that information, the materiel developer can proceed. Basis of issue plans, personnel impact, integrated logistical support, acceptable RAM risks, commodity manager handoff plans, detailed cost/budget estimates are important, but they can proceed in parallel and need not slow down the request for proposal contracting actions of the materiel developer. Yes, there is some risk associated with this accelerated RD&A cycle, but to compress time, as the cycle must, calculated risk must be taken. The Army's training device regulation, which is now being revised, must be tailored around expediting and making exceptions to the "normal" RD&A themes.

RAM criteria — though they vary with each device — must be tailored to the training criteria stated by the user. For instance, if a device is to be used statically in the breech of a gun, there is no reason to subject it to 40-foot drop tests. RAM and the associated testing of RAM features should be approached differently than in weapon system/hardware development. Testing should be to determine what the RAM characteristics of the tested item are rather than to determine whether predetermined RAM criteria are met. This testing should be secondary to that which should determine whether the device does what the trainer/user wants. The acceptability of the demonstrated RAM characteristics then should be the joint decision of the customer — the field trainer or his TRADOC representative who knows the environment in which the hardware will be used — and the commodity manager who will be responsible for the actual logistical support of the system. Note that while the materiel developer was not included, he should react to the decision. Further, the Logistics Evaluation Agency—now by regulation the voting representative of the "logistician" at decision reviews—was not included. Though that agency is important for independent assessments, it has no stake in actual implementation.

Management Diversity

The management structure for the development of training devices needs modification. As mentioned earlier, there are too many participants in the current system. As brief background, in 1972 the Chief of Staff of the Army, partly as a result of recommendations of the Board for Dynamic Training, ordered the establishment of a group known as the Combat Arms Training Board to stimulate and improve training Army-wide. That group, since renamed the Army Training Board, was given a very broad and powerful charter and substantial funding to allow it to function "outside of the system." Part of the group's effort was devoted to the development and acquisition of training devices. Members of the group wrote training device requirements, staffed them directly with the field, schools, materiel developers, and logisticians, and expedited, through Department of the Army staff officers, the central approval process. Requirements generation and staffing were accomplished very quickly. However, to "systematize" the process, it was recommended to the Commander, TRADOC, *that a project manager for training devices* be established within DARCOM (then AMC), and that a similar TRADOC organization be established and be collocated with the project manager to expedite device development efforts. In concert with the Commander, DARCOM, this was implemented. A Secretary of the Army-chartered project manager for training devices (PM TRADE) and a similarly manned TRADOC Training Device Requirements Office (TRADER) were established in 1974 and were collocated at Fort Benning, Ga. The Army Training Device Agency (ATDA), the agency previously responsible for development and logistical support of training devices, was made subordinate to the project manager. That agency was collocated with the Navy Training Equipment Center in Orlando, Fla.

PM TRADE was not chartered to develop all training devices; those devices to support project-managed weapon systems remained within the purview of the system project manager. PM TRADE was, however, to be available for consultation and could be employed to develop the devices if the system manager so chose. TRADER was the direct TRADOC representative for all project managers. In 1976, organizational consolidations led to the physical separation of PM TRADE and TRADER. PM TRADE consolidated with ATDA in Orlando and TRADER became a directorate subordinate to the newly formed Army Training Support Center (ATSC) at Fort Eustis, Va.

That action weakened the management system. As a subordinate of the ATSC, after having been directly subordinate to the TRADOC Deputy Chief of Staff for Training, the training device directorate lost its directive charter *vis-à-*

vis relations with TRADOC schools. Though the agency kept the responsibility for being the user representative and TRADOC focal point for training device development, the schools were saddled with the major responsibility of requirements generation and staffing. Coupled with the schools' already burgeoning, diverse responsibilities, as well as reduced manning priorities for the training device directorate, the TRADOC portion of the requirements generation process bogged down. At the same time the staffing process, as mentioned above, became more expansive. The result was programs slipped for lack of approved requirements documents, the budgeted funds were diverted for they could not be obligated without an approved document, and RD&A programs were postponed.

Needed is a TRADOC agency with a directive charter similar to that of a DARCOM project manager. The charter must be based upon the central theme of expediting the development of training devices. That agency cannot be a part of a staff and be effective—it must be an operating agency. This approach is not far different from the concept of the TRADOC system manager; however, this agency cannot be so lightly manned. Members of the agency should be predominantly military officers who can work directly with experts in the schools to structure requirements, do the staffing "legwork," and free those in the schools from technical or bureaucratic trivia. The agency must have the authority to fully represent the user community.

Funding Dilemmas

For years, training device funding was minimal. With the establishment of the PM TRADE office, and a coincident recognition by those who were at the highest levels of the Army hierarchy at the time that simulation offered significant dividends in the face of escalating costs, substantial funds were programmed to support non-system training device RD&A. However, funds programmed and those actually obligated have recently been significantly different. Figure 5 illustrates this quite vividly. In terms of total dollars, PM TRADE has but 46 percent of the programmed money available to support non-system training device research and development. Forty-six percent of that money was diverted for other purposes. The rest is to pay project manager employees. The administration's efforts to balance the budget have led recently to substantial cuts in FY 1982 and 1983 programmed funds. Also, recent programming changes require each "new start" training device program to compete with major programs for funds; thus, the future of training device developments is in grave jeopardy.

There has been a considerable amount of other procurement, Army (OPA), funds released to PM TRADE in fiscal 1980 (97 percent released, 3 percent retained by DARCOM); however, 97 percent of the funds available were devoted to the purchase of some of the components of the multiple integrated laser engagement system. The remaining money represents purchases within but two minor training device programs.

FIGURE 5
FY 1980 Research and Development Funding Projections*

Type Funds	Percent Available for Device Obligation	Percent Retained at DARCOM or DA Level	Percent Lost on Program Termination	Percent for Internal PM Operations
Concept (6.2)	89%	11%		
Validation (6.3)	17.7%	42.4%	39%	
Engineer Div (6.4)	61%	20%		19%

*Percentage rather than actual figures are used herein because of the sensitivity of funding levels

The fact that funds have been released to PM TRADE does not mean they will be obligated as planned. As mentioned earlier, if an approved requirements document is not available, the funds cannot legally be obligated. If the contracting process—which habitually takes six to nine months—cannot be completed before the last quarter of the fiscal year, there is a good likelihood DARCOM will reprogram the funds to other programs, with a resultant delay in contract award until the next fiscal year. Obviously, this will require reprogramming either internally at PM TRADE or within DARCOM to restore all or part of the funds lost.

Another problem facing PM TRADE is the advantage small business firms enjoy in competitive programs. Given the normally low-dollar program levels, small businesses often use their procurement regulation competitive advantage to obtain contracts that are beyond their capabilities. System project managers budget and program funds to support the development of system training devices even though they may have PM TRADE conduct the RD&A effort. The problem that has traditionally plagued these programs is that when more money is needed in the weapon program itself, there is a tendency to divert funds from the training device development. The result is that system device RD&A programs either slip to program years, are reduced in scope below original user-stated requirements, or are cancelled.

What is the solution? Should the various-level reprogramming authority be withdrawn? No! That authority, even if it could feasibly be altered, is necessary for overall management latitude. What is necessary in the training and materiel development communities is the recognition that deployment of a piece of weapon system hardware is not enough: there must also be at the same time a system available to train the soldier to use it effectively. Department of Defense directives and DA implementing regulations give clear direction — the system will not be fielded without a total support package. Required is enforcement of these directives.

Logistical Support System Inadequacies

Logistical support for some training devices has remained outside the commodity manager system. PM TRADE assumed a logistics support mission when the Army Training Device Agency was subordinated to it. The system essentially worked at the user level either through the post Training Aids Support Office (TASO) or direct to PM TRADE for direct or general support maintenance or replacement. Depot support was provided centrally by Tobyhanna Army Depot.

The Commander, DARCOM, has ordered that system changed to free PM TRADE from this logistical burden. He has ordered the appropriate commodity managers to assume the responsibility. There are likely to be great problems with this decision. The preponderance of the training devices in the system are non-type classified since they are low-density items. In the past, central DS/GS management of these devices was effective in that most have no technical data package and the facilities at the Naval Training Equipment Center have, in many cases, fabricated parts for them. Additionally, personnel involved, both at the depot and in the ATDA-derived apparatus, are experienced in making this "non-standard" operation work. In addition to the cost of adding these devices to the commodity system, these "exceptions" may be extremely demanding on the commodity commands.

The Training Aids Support Office is the weak link in the logistical system. It provides direct user interface and represents the only organizational-level maintenance activity. However, these offices—a single facility in Europe and numerous Forces Command-controlled facilities in the United States—are ill-equipped and inadequately manned to provide other than rudimentary organizational services. To impose organization maintenance of training devices on unit personnel has always been an unacceptable solution. Thus, what devices have been available at unit level have generally been contractor-supported through the PM TRADE system. This system is inappropriate for high-density devices designed for use by field units. An example of the recognition of this weakness was the decision of the Commander, TRADOC, to suspend fiscal year 1981 purchases of potentially invaluable multiple integrated laser engagement system components because of the lack of an adequate logistical system to support these items Army-wide.

It seems the only feasible solution to the logistical support problem for high-density training devices is the commodity command system. At the unit level these items should be turned over to post-level maintenance facilities on an exchange basis. From there repairs can be done either by contractor support or with the post resources. Europe and Korea have different problems. Contractor support may work in some cases; however, GS-level maintenance facilities may be required to support certain high-density items like the multiple integrated laser engagement system. Non-type-classified, low-density items perhaps should better continue to be centrally managed—Tobyhanna Army Depot seems the best solution.

Summary

Contained herein have been several ideas about the training needs of the Army in the field. The discussion has been general rather than highly detailed. It is a fact the Army is facing severe cost growth in every area that relates to field-level training. The Army budget has not kept pace, nor will it in the future. Units in the field can no longer afford to train as they have in the past, and with the introduction of new, more costly and longer-range weapon systems, the situation gets worse. Yet they cannot achieve the maximum effectivenes of their sophisticated weapons systems unless they can train the soldier element of the system. Simulation provides an affordable solution to this dilemma, but the development community cannot now provide the simulators needed in a timely manner. What must be done? First, the U.S. Army must recognize the cost problem facing field units—that is happening now. Secondly, the Army must get serious about simulation. Sufficient money must be provided and must be left in the programs. The management structure must be streamlined, and a logistical system that will be effective, yet not a burden to field units, must be developed. The solutions advanced herein are not the only ones; they are the opinion of the author. The point is the Army *must* solve the generic problems cited quickly. The effectiveness of the force depends upon that solution.

Economic Escalation Application in Program Management

66

Seymour Uberman

Congress requires that every Department of Defense (DOD) request for appropriation include all the dollars that will be outlaid (or expended) against that appropriation. This requires that DOD take into account in its request for appropriation the effect of the anticipated inflation. Economic escalation is the way in which we counteract the effects of the anticipated inflation in establishing our appropriation requirements. The General Accounting Office (GAO) attributes 30 percent of the cost growth in major acquisition programs to economic changes (greater than an anticipated inflation).[1]

To promote uniformity in the treatment of escalation in the Department of Defense, the Assistant Secretary of Defense (Comptroller) has, since 1970, provided uniform guidance in the form of price-level or escalation indices and outlay rates by appropriation. In turn, each service comptroller incorporates this guidance into service-peculiar instructions for the preparation of the program objectives memorandum (POM) and budget. Although the instructions differ by service, the basic escalation applications are the same. This paper will address those applications.

Two factors are recognized as contributors to the escalation calculation and must be incorporated into our requirements estimate:

—Changes in the price level or escalation index over time with reference to a base year.

-- The outlay or expenditure rate which accounts for the time difference between the receipt of the appropriation and the expenditure of funds over time.

Cost estimates are prepared in constant dollars to eliminate the distortion that would otherwise be caused by price-level changes. This requires the transformation of the historical or actual cost data into constant dollars so that the resulting cost-estimating relationship will be in constant dollars. This is accomplished by using the same two factors as were cited above, but in reverse order.

This paper will show how a price level index is developed, describe how an outlay profile is used, and then combine the index and the profile into a composite or weighted index. (Terms are defined in the Glossary.) The price-level index provides the price level, which reflects the escalation rate by fiscal year relative to a base year. The outlay profile provides estimated percentages of the expenditures to be made in each year for obligation in a given year. Using both we can develop current- (or then-) year as well as constant-year dollars required for use in POM and budget submittals.

Seymour Uberman is an independent management consultant in Los Angeles, Calif. He was formerly Professor of Financial Management at the Defense Systems Management College, where he taught cost estimating, life cycle design to cost, budget formulation and execution, and corporate financial management. Mr. Uberman holds a B.A. degree in physics from Brooklyn College.

1. House Report No. 96-656, *Inaccuracy of Department of Defense Weapons Acquisition Cost Estimates.*

Given actual inflation rates for past years and predicted rates for future years we will construct a price-level index. Constructing the index is a straightforward application of the factors or rates; however, deriving the rate for each year is a far more complex process and will be left to the economists. Figure 1 illustrates the construction of a price-level index and explains the method of calculation.

In doing escalation calculations, it is often necessary to take a price-level index relative to one base year and transform it into a price-level index relative to some other base year. This process is illustrated in Figure 2, and methods of calculation are shown.

In method 1 we know that the index for base year 6 is 100.0, by definition. Thus, if we divide every index number in base year 4 by 118.8 and multiply by 100, we transform the base year 4 index to a base year 6 index. In method 2 we followed the same process that we used in Figure 1.

We are now ready to see how an outlay profile is used in developing resource requirements. Outlay profiles are developed by the Office of the Secretary of Defense (Comptroller) and each of the service comptrollers by ongoing statistical analysis of actual outlays by appropriation over time. For our purpose, we will consider the outlay profile as a given along with a constant-dollar total cost

FIGURE 1
Developing a Price-Level Index

	FISCAL YEAR	INFLATION RATE	PRICE LEVEL INDEX	METHOD OF CALCULATION
ACTUAL RATES	1	5%	84.0	88.2 ÷ 1.05 = 84.0
	2	6%	88.2	93.5 ÷ 1.06 = 88.2
	3	7%	93.5	100 ÷ 1.07 = 93.5
BASE YEAR	4	8%	100.0	By Definition
PROJECTED RATES	5	10%	108.0	100 × 1.08 = 108.0
	6	12%	118.8	108 × 1.1 = 118.8
	7	10%	133.1	118.8 × 1.12 = 133.1

FIGURE 2

Transforming a Price-Level Index from Base Year 4 to Base Year 6

FISCAL YEAR	INFLATION RATE	PRICE LEVEL INDEX		METHODS OF CALCULATION	
		Base Yr 4	Base Yr 6	1	2
1	5%	84.0	70.7	$\frac{84.0}{118.8} \times 100 = 70.7$	$74.2 \div 1.05 = 70.7$
2	6%	88.2	74.2	$\frac{88.2}{118.8} \times 100 = 74.2$	$78.7 \div 1.06 = 74.2$
3	7%	93.5	78.7	$\frac{93.5}{118.8} \times 100 = 78.7$	$84.2 \div 1.07 = 78.7$
4	8%	100.0	84.2	$\frac{100.0}{118.8} \times 100 = 84.2$	$90.9 \div 1.08 = 84.2$
5	10%	108.0	90.9	$\frac{108.0}{118.8} \times 100 = 90.9$	$100 \div 1.1 = 90.9$
6	12%	118.8	100.9	$\frac{118.8}{118.8} \times 100 = 100.0$	By Definition
7	10%	133.1	112.0	$\frac{133.1}{118.8} \times 100 = 112.0$	$100 \times 1.12 = 112.0$

estimate, and in Figure 3 develop the dollar outlay by fiscal year using the outlay profile and the constant-dollar total cost estimate.

In Figure 4 we use the price-level index that was developed in Figure 1 to convert the fiscal year 4 constant-dollar outlay of Figure 3 to current or then-year dollars.

Another and less time-consuming way to convert a constant-dollar outlay to a current-year-dollar outlay is to develop a composite index by combining the outlay rate in percent with the price-level index. This enables us to do the conversion in only one step by using a composite index factor. In Figure 5 we will show

FIGURE 3
Use of an Outlay Profile

Given:

- **RDT&E Outlay Profile:**
  1st Year = 40%
  2nd Year = 50%
  3rd Year = 10%
- **RDT&E Cost Estimate:**
  50.0M in constant FY4 $
- **Outlay will start in FY4**

What is the outlay in dollars? (starting with FY4)

FISCAL YEAR	OUTLAY PROFILE	OUTLAY RATE FY4 $
4	40%	20.0M
5	50%	25.0M
6	10%	5.0M
		50.0M

FIGURE 4
Converting Constant Dollar Outlay to Current Year Dollars

FISCAL YEAR	PRICE LEVEL INDEX BASE YEAR 4 (1)	OUTLAY FY4$(2)	OUTLAY CURRENT YEAR $	METHOD OF CALCULATION
4	100.0	20.0M	20.0M	20.0 × 1.0 = 20.0
5	108.0	25.0M	27.0M	25.0 × 1.08 = 27.0
6	118.0	5.0M	5.9M	5.0 × 1.188 = 5.94
	TOTAL	50.0M FY4$	52.9M CURRENT YEAR $	52.94

(1) From Figure 1
(2) From Figure 2

FIGURE 5
Developing a Composite Index

FISCAL YEAR	PRICE LEVEL INDEX		OUTLAY PROFILE		WEIGHTING
4	100.0	×	40%	=	40.0
5	108.0	×	50%	=	54.0
6	118.8	×	10%	=	11.9
					105.9 Composite Index

50.0M (FY4$) × 1.059 = 52.95
This compared to 52.94 (From Figure 4)

how this is done. The composite index is provided by each of the service comptrollers as part of the POM budget preparation guidance.

In the cost-estimating application we have historical cost data in the form of actual dollars by year of outlay. Such dollars are then- or current-dollars and include the inflation actually incurred in the year of outlay. In Figure 6 we will

FIGURE 6
Converting Actual to Constant Dollars

FISCAL YEAR	ACTUAL DOLLARS (M)	PRICE LEVEL INDEX (BASE YEAR 4)	CONSTANT DOLLARS BASE YEAR 6 (M)	METHOD OF CALCULATION USING FORMULA: $\frac{YRX\$}{\text{Index YRX}} = \frac{YRY\$}{\text{Index YRY}}$ Where Year X = FY1,2,3 or 4 Year = 6
1	25.0	84.0	35.4	$\frac{25}{84} = \frac{YR6\$}{118.8}$ $YR6\$ \times \frac{84^{1}}{118.8} = 25$ $YR6\$ = 35.4$
2	32.0	88.2	43.1	$\frac{32}{88.2} = \frac{YR6\$}{118.8}$ $YR6\$ \times \frac{88.2^{1}}{118.8} = 32$ $YR6\$ = 43.1$
3	50.0	93.5	63.5	$\frac{50}{93.5} = \frac{YR6\$}{118.8}$ $YR6\$ \times \frac{93.5^{1}}{118.8} = 50$ $YR6\$ = 63.5$
4	40.0	100.0	47.5	$\frac{40}{100} = \frac{YR6\$}{118.8}$ $YR6\$ \times \frac{100^{1}}{118.8} = 40$ $YR6\$ = 47.5$
5 6 7	— — —	108.0 118.8 131.1		

NOTE The factors $\frac{84}{118.1}$, $\frac{88.2}{118.8}$, $\frac{93.5}{118.9}$ and $\frac{100}{118.8}$ accomplish the base year transformation depicted in Figure 2 Method 1

show how such actual dollars are converted to constant base-year dollars for use in a cost estimate. The base year of the estimate is given as year 6, whereas the price-level index is given as year 4. This small complication is introduced in order to bring out a more general way to convert year *X* dollars to year *Y* dollars with a single price-level index a base to year other than *X* or *Y* by means of a single formula that follows.

$$\frac{YRX\$}{\text{Index } YRX} = \frac{YRY\$}{\text{Index } YRY}$$

Given:

- A Price-Level Index to any base year
- YRX$

The equation can be used to solve for YRY$

GLOSSARY

Actual Dollars—Historical expenditures from prior time periods that reflect the inflation for the years in which the expenditures were incurred.

Base Year—A reference period that may be past, present, or future, which becomes a fixed level for comparison in cost analysis and economic escalation calculations. The price-level index for the base year is 100.0 in escalation calculations.

Composite Index—Combines price-level changes, and outlay rate is used in converting constant-dollar costs to current dollars in a single calculation.

Constant-Year Dollars—A phrase always associated with a base year and reflecting the dollar "purchasing power" for that year. An estimate is said to be in constant dollars if costs for all work, prior, current, and future are adjusted so that they reflect the level of prices of the base year. When cost estimates are stated in constant dollars, the implicit condition is that the purchasing power of the dollar has remained unchanged over the time period of the program being costed.

Current-Year Dollars—Current-year dollars reflect purchasing power current to the year the work is performed. Prior costs stated in current dollars are the actual amounts paid out in these years. Future costs stated in current dollars are the projected actual amounts which will be paid. Care should be exercised to preclude the mixing of current dollars with constant dollars in a single display of costs. This may occur when a program has some expended (sunk) dollars associated with it; and these actuals are left in the purchasing power of the years in which expended, while out-year costs are expressed in constant dollars.

Economic Escalation—This is the change in price levels due to economic effects. Actually, it is the difference between base-year dollars and current-dollars for a particular expenditure.

Expenditure Profile—The time-phased estimate of a program's annual expenditure. The term may be applied to the expenditure of a given year's appropriation over time.

Factor—A number derived from an index for the purpose of escalating or de-escalating costs (base-year factor - 100.0).

Price-Level Index—A numerical series which would result if current-year dollars were divided by base-year dollars for all years in an expenditure pattern.

73 Improving Cost and Schedule Controls through Adaptive Forecasting

Dr. George K. Chacko

Control of costs and schedules is a dominant concern of defense systems acquisition management in both government and industry. The Comptroller General's Reports to Congress since 1975 show that each year major defense systems cost more than their base-line estimates. Further, the increases themselves increase from year to year. The percentages of increase over the base-line have risen to the point that they are now more than 50 percent. The dollar increases on major defense programs were $83 billion in 1978,[1] $113 billion in 1979,[2] and $150 billion in 1980;[3] and the percentage increases over the base-line estimates were respectively 42 percent, 54 percent, and 52 percent.

While the costs increase, the schedules slip. The Defense Science Board reports that the time from Milestone 0 to Milestone I has lengthened significantly from less that 2 years prior to 1950 to nearly 5 years in 1974.[4] A paper presented at the Ninth Annual DOD/FAI (Federal Acquisition Institute) Acquisition Research Symposium indicates that the total time to develop and produce new aircraft to initial operational capability (IOC) has been increasing at the rate of 3 months per year for the past 15 years, while the interval from design contract to first flight remains constant.[5]

These sizable cost increases and schedule slippages could not be attributed to any paucity of data. Based on the extensive survey that the National Security Industrial Association (NSIA) conducted to develop a Cost/Schedule Systems Compendium (30,000 pieces of data representing $14 billion in current contract value), about 1,056,000 pages of cost account documentation are created Each

1. The Comptroller General, *Financial Status of Major Federal Acquisitions, September 30, 1978*, General Accounting Office, Washington, D.C., PSAD-79-14, January 11, 1979, p. 5.
2. The Comptroller General, *Financial Status of Major Federal Acquisitions, September 30, 1978*, General Accounting Office, Washington, D.C., PSAD-80-25, February 12, 1980, p. 5.
3. The Comptroller General, *Financial Status of Major Federal Acquisitions, September 30, 1980*, MASAD-81-13, March 20, 1981, p. 5.
4. Defense Science Board, *Summer Study of 1977*, Department of Defense, Washington, D.C., March 1978.
5. Rear Admiral L. S. Kollmorgen, "Affordability Is Not a Dirty Word," Paper presented to Ninth Annual DOD/FAI Acquisition Research Symposium, U. S. Naval Academy, Annapolis, June 1980.

Dr. George K. Chacko is Professor of Systems Management with the University of Southern California (Institute of Safety and Systems Management). During the past 25 years he has applied computer technology to decision making in a wide variety of fields, ranging from consumer and durable products manufacture and marketing, to defense systems acquisition and crisis management. He was Visiting Professor of Systems Management in 1972-73 at the then Defense Systems Management School. Dr. Chacko holds a Ph.D. degree in econometrics from the New School for Social Research.

Month by DOD contractors in order to satisfy government requirements, averaging 2,672 pages for each Cost/Schedule Control Systems Criteria (C/SCSC) application.[6]

Despite the size of such reports, Defense Secretary Caspar Weinberger and Budget Director David Stockman have found it necessary to assure Congress that rigorous program management will be pursued. In a joint letter to Senate Budget Committee Chairman Pete Domenici, the two Cabinet Officers wrote: "Furthermore, we want to assure you that as part of our overall effort to constrain federal spending growth and eliminate the deficit by FY 1984, we plan to impose rigorous program management responsibilities on all agencies, including the Department of Defense, to assure that outlays do not exceed estimates."[7]

Obviously, a better method of estimating costs is needed so that those costs can better be controlled. An accurate forecast of tomorrow's actuals (such as actual cost of work performed-ACWP) compared with corresponding plans (such as budgeted cost of work performed-BCWP) can provide the expected cost excess (BCWP-ACWP). These are standard data elements in the contractor-supplied cost performance reports.

The question is, can a better forecasting method be developed? Can the special features of a program be studied in order to yield a clue as to how the program may behave in the future? If such a customized calibration could be made, it would have the advantage of being completely founded upon the experience to date of that particular program; hence, it would have greater validity in guiding the program controls. In fact, such a forecasting method *has* been developed. I call it "adaptive forecasting."

To test the adaptive forecasting method, industry and government systems acquisition management offices provided data on ongoing multi-billion-dollar programs. In some instances, data for a year such as 1979 were given, with the challenge being to "forecast," month by month, the performance of the program in 1980. The actual performance was, of course, already known to the program office. To protect the identity of the data sources, we will refer in this paper to all sources, industry and government, by the same titles, such as "program office," or "program manager," without specifying any service or contractor.

One question to be answered was whether, by comparing month-to-month forecasts with actuals, it could be determined which particular elements of the program were most responsible for the variances in both positive and negative directions. For example, given that the program is expected to be over cost in the next month by, say $1.5 million, which of the several components of the system contribute most to the cost excess? If 2 out of a total of 24 components contribute,

6. National Security Industrial Association, "Cost Schedule Systems Compendium," NSIA, Washington, D.C., 16 September 1980, p. 9

7. David Stockman and Caspar Weinberger, "Letter to Senate Budget Committee Chairman," May 11, 1981.

say, 85 percent of the $1.5 million, how much of the excess at the component level is realistically controllable?

To provide a good test of how well adaptive forecasting could answer these questions, the identity of the elements used in the test were camouflaged, being identified only as "Component 1," "Component 2," etc. The only requirement was that the sum of the values under all the components equal the column marked: "Total of All Components."

So far, we have only considered the forecast for "next month" (or the next data point). What about the longer term? If we observe the program for a year, can we say something about next year (or beyond) with reasonable confidence? Can we give a reasonable profile of the future?

And what about schedules? With this forecasting method, accurate estimates of budgeted cost for work performed (BCWP) can be compared with the corresponding budgeted cost of work scheduled (BCWS) to arrive at expected schedule slippage. Not only must the next data-point be forecast accurately, but also the near- and long-term performance of schedule elements, as in the case of cost elements.

Forecasts of non-dollar elements were also made. Manpower requirements for use in the 5-year plan had to be developed, not on the basis of manpower data, but on surrogates of manpower requirements. For the test, these forecasts were compared with manpower requirements developed by traditional methods.

What Is Different About Adaptive Forecasting?

To get an idea how adaptive forecasting works, let's look at data from a segment of a major acquisition program.

Figure 1 shows the 24-month data on a program segment that starts with $3,241,000 within month 1 and ends with $5,869,000 within month 24. If we decide that a linear fit is the most appropriate way to post this data, we develop a linear fit to the data as illustrated by the free-hand fit in Figure 2.

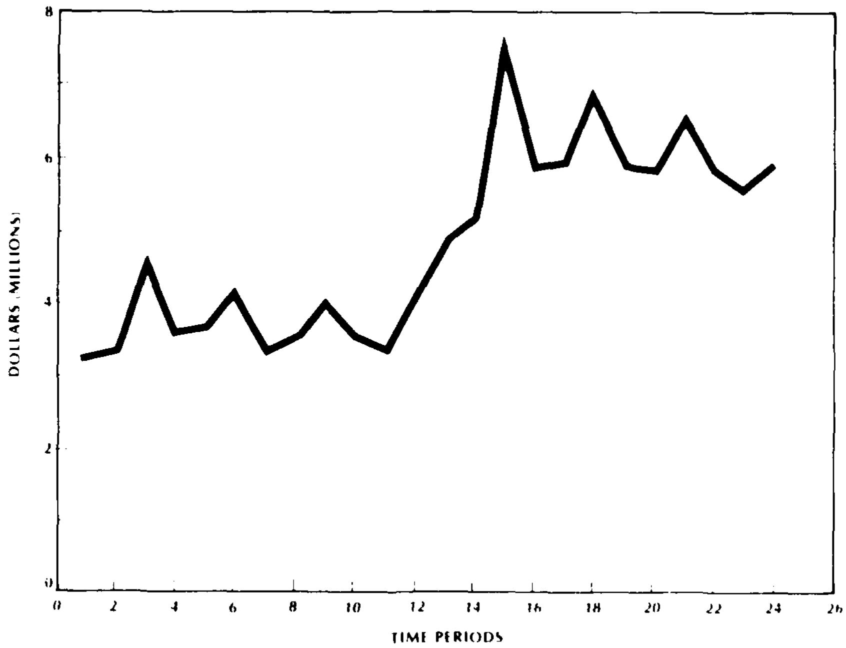
We could decide that a curvilinear fit is the most appropriate, in which case we develop a curvilinear fit, as illustrated by the free-hand fit in Figure 3.

Note that *we decided* that a linear or a non-linear fit was the most appropriate, based on whatever reasoning chosen. We are *fitting the data to the model*.

In adaptive forecasting, we reverse the process, and fit the model to the data. Furthermore, we fit a *new* model with every new data-point. Given the rather violent up and down movements of actual acquisition data, any pre-conceived notion as to linear or non-linear fit appears, at best, artificial.

With adaptive forecasting a minimum of two points is required to forecast the third. We feed the data on data-points 1 and 2 to "forecast" the third point. (We use the term "forecast" even though the third point in this example is already known.) What the method does is find out how best to use the first and second points to most accurately estimate the third.

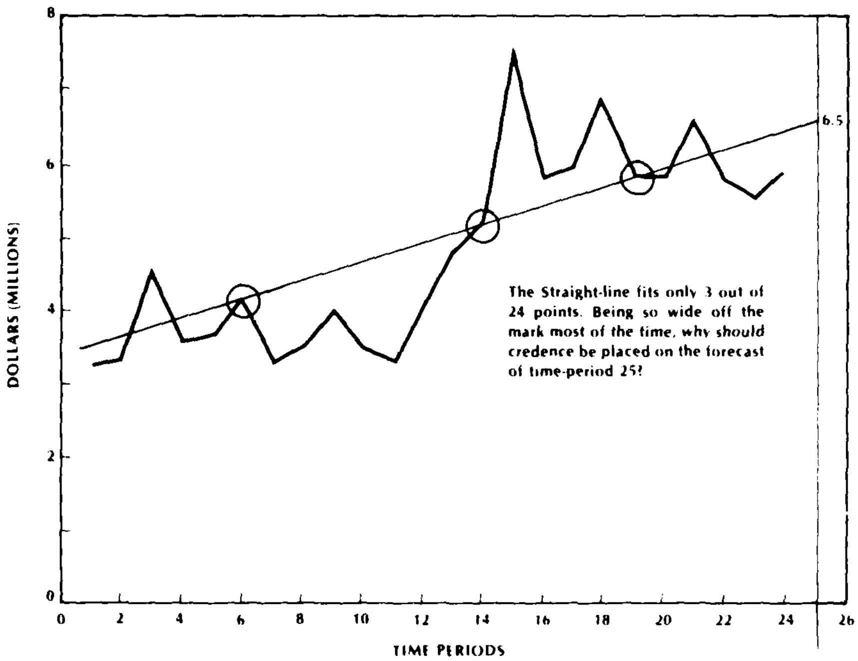
FIGURE 1
Observed Data for 24 Time Periods



The forecast for point 3 is then compared with the actual value of point 3. Based on the difference between the forecast and the actual, a *new model* is created using points 1, 2, and 3 to forecast point 4. This forecast is compared with the actual value and again a new model is created using points 1, 2, 3, and 4 to forecast point 5. Thus, each new model is *adapting* the model to the experience with forecasting the data up to that data-point.

The experience with a wide variety of types of data to date has been that by the fifth data-point, the forecast is quite close to the actual, and from then on tracks even jagged saw-tooth-like data pretty much like a heat-seeking missile.

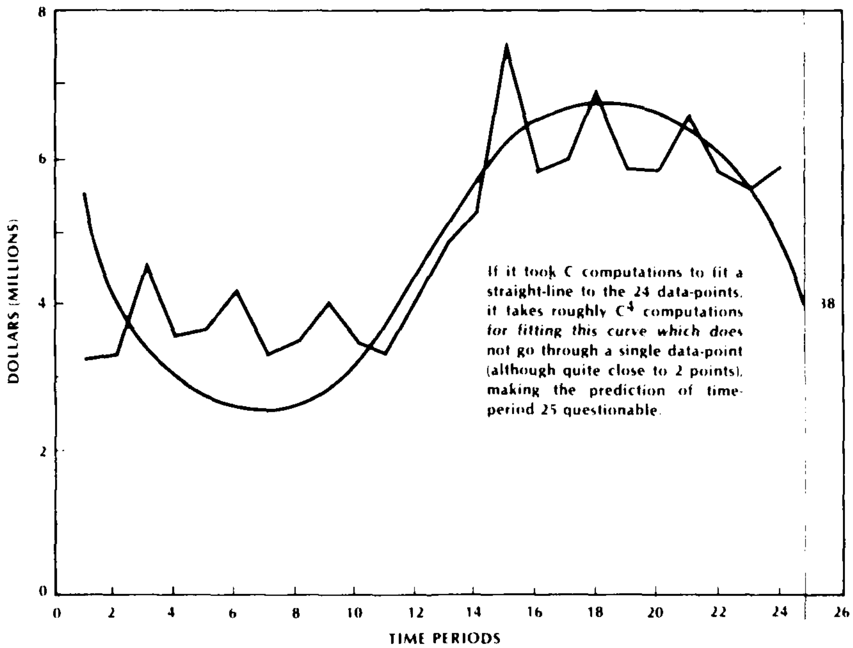
FIGURE 2
Free-hand Straight-line Fit



Validation of Forecasts Using Available Experience

When we impose our own prejudices as to what model will fit the given data, e.g., the straight line in Figure 2 or the curve in Figure 3, we take the forecast of data-point 25 not on the basis of any evidence that our hunch was indeed right as shown by the number of actuals falling on the straight line or the curve, but on the laws of probability that the actual will lie somewhere between the forecast and a value higher (lower) *in the long-run*. In other words, there is no way to check the efficacy of the linear or non-linear fit by checking how often it forecasts "right on the money." We see that 3 out of the 24 data-points lie on the free-hand

FIGURE 3
Free-hand Curvilinear Fit

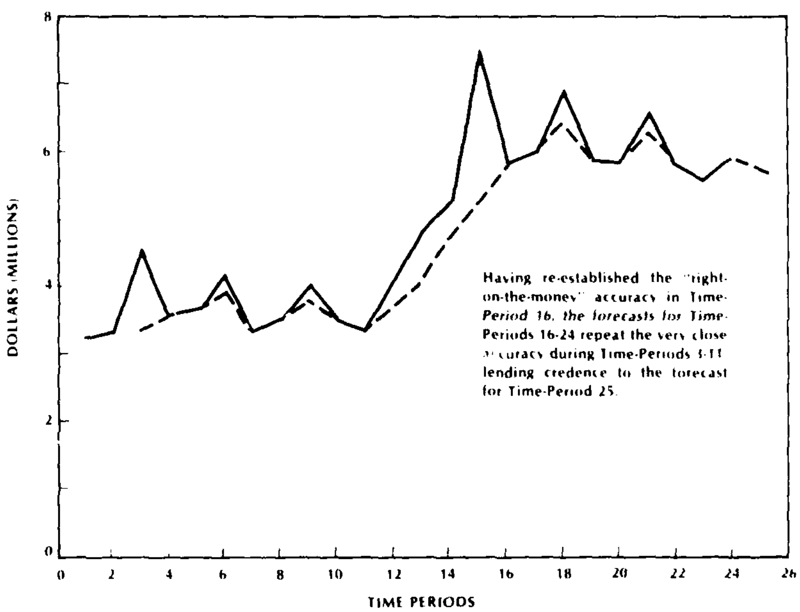


straight-line fit in Figure 2. Not a single point actually lies on the free-hand curve fit in Figure 3, but 3 out of the 24 data-points are very close. In other words, 87.5 percent of the actual data-points were *not* forecast by the two models chosen; *only 12.5 percent of the data-points* were "right on the money."

In Figure 4, the first forecast is that of data-point 3, the second, of data-point 4, and so on for a total of (24 - 2 =) 22 forecasts. We find that 13 out of 22 forecasts are "right on the money"; and an additional 4 are quite close, making 17 out of 22, or 77.3 percent of the forecasts truly accurate (compared with only a sixth of such instances of accuracy, i.e., 12.5 percent, for the linear and non-linear model fits).

In Table I, the numerical values of the forecasts and the actuals are shown. The fit index in Column 3 is a function of the difference between the forecast and the actual. Ignoring the very first forecast of data-point 3 (which, being the very first, is not expected to be too close), the only major divergence is at data-point

FIGURE 4
MESGRO Forecast 25th Time Period



15. Considering the dramatic jump in the given data from $5,219,000 (data-point 14) to $7,545,000 (data-point 15), the divergence is quite understandable. When we look at the numerical values in Table I, we find that 20 out of 22 forecasts are quite close, giving a record of 90.9 percent accuracy, compared with 12.5 percent of the linear and non-linear fits.

Increasingly Close Ranges of "Forecasts"

While the 90.9 percent accuracy is indeed most gratifying, we need to provide a range for the forecasts, particularly forecasts of acquisition data exhibiting great fluctuations.

We have done this in Figure 5. The given data are shown as a solid line, bounded on the bottom by a closely broken line, and on the top by a wider-broken line. The closely broken line is the forecast, while the wider-broken line is the "trend-adjusted forecast." Since trend is a persistent, long-term tendency of program costs to either increase or decrease, we use the term "trend" loosely when we look for a trend in only two or three data-points.

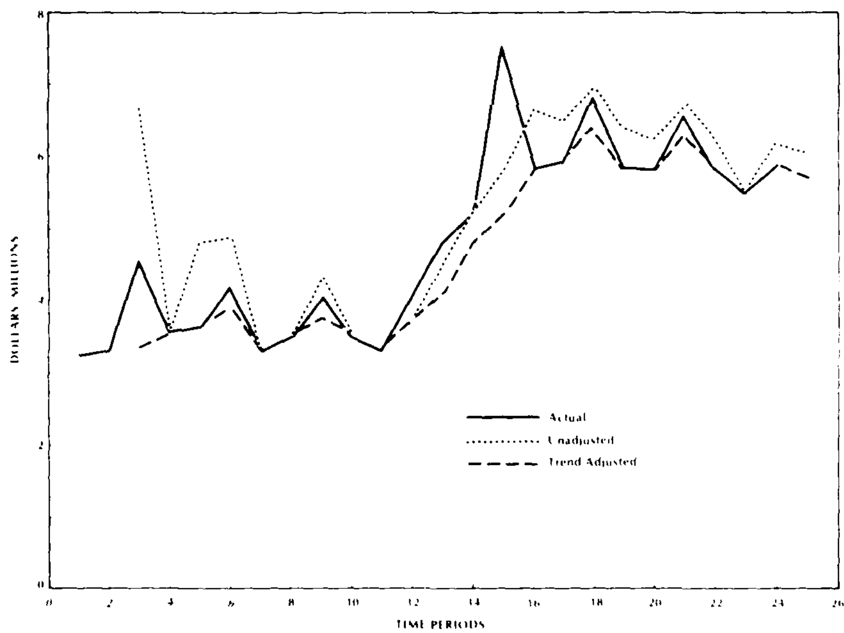
TABLE I
Very Close Forecasts by MESGRO

ACTUAL	FORECAST	FIT INDEX
3,241		
3,327		
4,556	3,326	454
3,552	3,551	0
3,636	3,636	0
4,160	3,908	16
3,295	3,295	0
3,500	3,500	0
4,025	3,778	16
3,512	3,513	0
3,337	3,338	0
4,076	3,743	29
4,802	4,071	131
5,219	4,790	38
7,545	5,204	1,052
5,835	5,833	0
5,948	5,956	0
6,863	6,417	31
5,835	5,838	0
5,828	5,823	0
6,552	6,284	11
5,807	5,806	0
5,530	5,529	0
5,869	5,868	0

The procedure is similar to the one discussed earlier. The trend-adjusted forecast for data-point 3 builds into it a factor for the trend, and therefore will be higher (lower) than the regular forecast, which we will call "non-trend-adjusted" to distinguish it from the "trend-adjusted." The actual value of data-point 3 is compared with the trend-adjusted forecast, and a new model is developed using data-points 1, 2, and 3 to forecast data-point 4, and so on.

The trend-adjusted forecasts take longer to settle down than the non-trend-adjusted. By the same token, we also see that when a clearly rising trend is evident, such as the one between data-points 11 and 15, the trend-adjusted forecasts are closer to the actual values. They achieve the closeness faster and retain it while the trend continues.

FIGURE 5
MESGRO—Planned



Application 1: Near-Term Dollar Forecast

The data presented in Figure 1 are budgeted figures for a segment of a major acquisition system. In Figure 5, the budgeted figures are identified as planned, and the trend-adjusted and non-trend-adjusted figures are shown bracketing the planned (budget) figures.

The program manager wants to know: "What is the most accurate forecast that I can have of the next time-period?" The answer is $5,743,040. What is the most accurate *range*? The answer is $5,743,040 to $6,049,510. In this forecast of the 25th data-point (month), the program manager has the assurance that, based *only* on the experience of the 24 months, the 25th-month figure will be *not less than* $5,743,040, nor more than $6,049,510.

Is this accuracy necessary? The bigger the program, the greater the penalty for the inaccuracy. On a $100 million segment of a major program, as little as a 5 percent error means that the program manager must have $100 million when he has planned to spend $95 million, forcing him to scramble for an additional $5 million at quite possibly *higher* interest. While the program manager himself may not physically do the borrowing, he is indeed causing the avoidable additional expenditures by under estimating to the tune of $5 million. Similarly, he would be unnecessarily holding $5 million in idle funds by estimating the required funds the next month at $105 million when just $100 million is adequate.

Even with the higher defense budget under the Reagan administration—perhaps because of it—the Congress is increasingly interested in increases in acquisition program costs. On May 14, 1981, the senators, by a vote of 96 to 0, adopted an amendment requiring a public report to Congress on cost overruns of *more than 15 percent on research and development contracts* or *10 percent on procurement contracts.*[8] Clearly, closer forecasts of the future, by themselves will not eliminate cost overruns; but they cannot but help anticipate them, allowing remedial (preventive) actions to be taken.

Application 2: Near-Term Expected Cost Excess Controls—Aggregate

Cost overruns cannot be controlled unless they are anticipated. Defining cost excess as actual-planned, or ACWP-BCWP, it is the *expected* cost excess that has to be determined. For instance, with respect to the acquisition data we have been discussing, we need to know the expected cost excess for the next data-point, i.e., the 25th month.

The data we have been discussing are *planned* costs of the particular segment of the acquisition program. To determine the cost excess in month 25, we need to know the corresponding *actual* costs. We present the observed data for the 24 months, enveloped by the estimates—both non-trend-adjusted and trend-adjusted—in Figure 6. The forecast of actual costs in month 25 is $7,147,450. The range is $7,147,540 to $7,676,860.

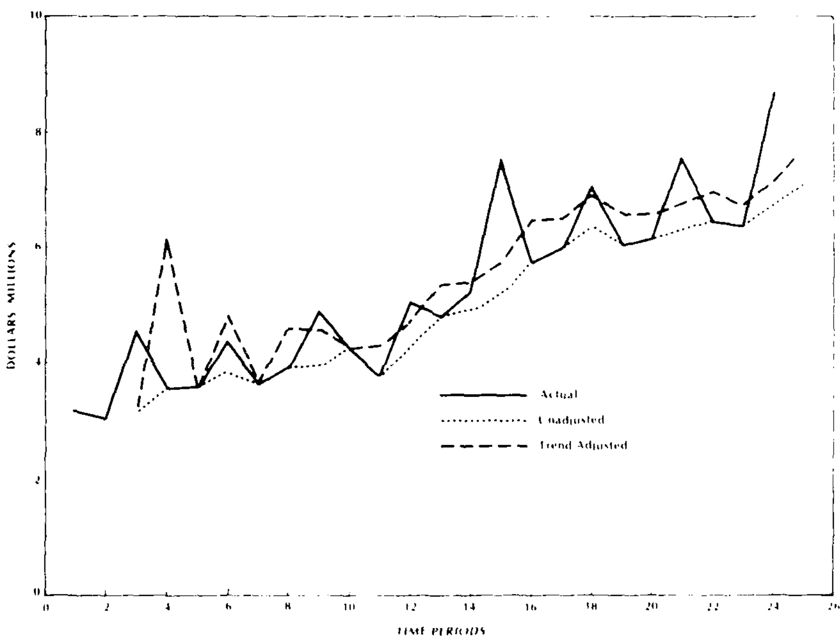
Expected *planned* costs in month 25:	$5,743,040
Expected *actual* costs in month 25:	$7,147,450
Expected *cost excess* in month 25:	-$1,404,410

Since non-trend-adjusted forecasts made so many right-on-the-money hits, the program manager can indeed count on the program segment to be over cost $1.4 million in month 25. However, he can also have an upper limit of the [illegible] cost excesses, derived as follows:

[illegible]ed expected planned costs in month 25:	$6,049,510
[illegible] expected actual costs in month 25:	$7,676,860

[8] [illegible] Arms Bill Is Approved by Senate," *The Washington Post*, May

FIGURE 6
MESGRO—Actual



Trend-adjusted expected cost excess in month 25: -$1,627,350

The program manager can expect the cost excess in month 25 to be not less than $1.4 million and not more than $1.6 million.

Application 3: Near-Term Expected Cost Excess Controls—Components

Given that the program segment is expected to be over cost by $1.4 million in month 25, what can the program manager do about it?

The way to control the aggregate is through its components. The aggregate of $3,241,000 in month 1 of the data we have been discussing is made up of Component 1 ($938,000), Component 2 ($1,574,000), Component 3 ($120,000), . . . ,Component 8 ($51,000), and Component 9 (*negative* $158,000). The aggregate can be broken up into as many components as are appropriate to take effective actions to control them.

We find from Table II that about two-thirds of the expected cost excess in

TABLE II
Expected Cost Excess Control

EC - SQUARED REPORT
(EXPECTED COST EXCESS CONTROL)

NON TREND ADJUSTED
AGGREGATION LEVEL 0 TOTAL COST
ACTION LEVEL 1 - 9

LEVEL 0 CATEGORIES						
	1	Component 1	2	Component 2	3	Component 3
	4	Component 4	5	Component 5	6	Component 6
	7	Component 7	8	Component 8	9	Component 9

LEVEL 0 COMPONENTS CONTRIBUTING MOST TC

EXPECTED VALUE OF [illegible] EXPECTED VALUE OF [illegible] = EXPECTED COST EXCESS

RANK	LEVEL	CATEGORY	EXPECTED COST EXCESS		CONTROL FACTOR		TARGETED CONTROLS
1	1	Component 1	$ 875.5)	62.3%)	40.0%	>	$ 350.2
2	5	Component 5	$ 141.5)	24.3%)	85.0%	>	$ 290.3
3	3	Component 3	$ 165.8)	11.8%)	85.0%	-->	$ 140.8
		LEVEL 0 COST EXCESS (+)	$ 0.0)	0.0%)	0.0%	(AVG.)	$ 0.0
		LEVEL 0 COST EXCESS (-)	$ 1382.6)	98.4%	70.0%	(AVG.)	$ 781.3
		TOTAL COST EXCESS	$ 1404.4)	100.0%	45.8%	(AVG.)	$ 781.3

LEVEL 0	***** ACTION T	CHOICE T-1	T-2	***** T-3	EXPECTED EXCESS T	TARGETED CONTROLS T	OBSERVED EXCESS T	(TARGETED - OBSERVED) SQ OVER TARGETED IN T	AVG
1	YES	YES	YES	YES	$ 883	$ 109	$ 227	43	29
2	NO	YES	YES	NO	$ 19	$ 0	$ 0	0	28
3	NO	YES	YES	NO	$ 113	$ 0	$ 0	0	35
4	NO	NO	NO	NO	$ 52	$ 0	$ 0	0	0
5	NO	YES	YES	NO	$ 203	$ 0	$ 0	0	35
6	NO	NO	NO	YES	$ 95	$ 0	$ 0	0	2
7	YES	YES	YES	NO	$ 20	$ 9	$ 2	0	1
8	YES	NO	NO	YES	$ 5	$ 5	$ 44	10	6
9	YES	YES	YES	NO	$ 30	$ 24	$ 116	21	7

month 25 is generated by Component 1; about a third by Component 5; and about a twelfth by Component 3. How much of this expected excess cost is controllable?

This depends on a number of factors. One important consideration is the particular stage-of-growth of the component. If the particular component is in *rapid growth*, it would be probably much harder to control the cost excess than if it were in *rapid decline* or *maturation*. The reason is that the intrinsic forces propel the curve in the upward direction (rapid growth), or downward direction (rapid decline), making it critical to know the nature and magnitude of those intrinsic forces, just as the pilot needs to know the wind velocity acting on his plane in order to effectively control the flight.

These intrinsic forces need to be calibrated with every new data-point. Does the added data suggest the continuation of the past, or a change from it? Can a change be perceived as being in the offing? The anticipation of a change in the stage-of-life is sometimes even more important than the recording of the continuing stage. The program manager needs to prepare to meet demands for a larger volume of funds if a change from infancy to rapid growth is suggested. Conversely, if a change from rapid growth to maturation is forecast, then he would want to curtail the flow of funds.

Based on the stage-of-growth of the component in question, and other factors such as the importance of the component to the aggregate, the responsivenes of the component to control measures in the past, a *control factor* is determined for the component. We see from Table II that the control factor for Component 1 is 40 percent. What does this mean? It means that Component 1 can be brought down to an excess cost of \$350,200 even though it is expected to be over cost by as much as \$875,500. In other words, the program manager needs to either find some other component whose excess can be *additionally* reduced by (\$875,500 - \$350,200 =) \$525,300, or he needs to find a component that is *under cost* by \$525,300, or reconcile himself to the cost excess of \$525,300 contributed in month 25 my Component 1.

Application 4: Recent History of Responsiveness to Controls—Components

Given two components with expected cost excess, which should be given immediate attention, or increased attention?

One of the considerations is this: How often has this component been significantly above or below cost, so that it has been selected for controls in the immediate past? We see from Table II that Component 1 has indeed been chosen for controls in the present period (Time T), the immediate past period (Time T-1), the period before that (Time T-2), and the period before that (Time T-3).

On the other hand, Component 5 was *not* chosen for controls in the present period (T). It was chosen for controls in the two preceding periods, but not in the period before that (Time T-3). This shows that Component 1 does require more immediate attention than Component 5.

Component 3 has a record of controls similar to that of Component 5. Since the contribution to excess aggregate costs by Component 5 is twice that of Component 3, the former needs more pressing attention.

When we turn to trend-adjusted forecasts in Table III, we find that a new component has been added, namely, Component 9. Unlike Components 1, 5, and 3 the new component chosen for controls is going to be *under cost* in month 25, in the amount of $49,700. The fact that Component 9 appeared only in the trend-adjusted forecast—and not in the non-trend-adjusted forecast—suggests that the effect of the next data-point would be worth watching. It should be noted, however, that Component 9 was chosen for controls in 3 out of 4 instances in the recent past, making it a more urgent candidate for controls than either Components 5 or 3, which were chosen only 2 out of 4 times.

Application 5: Near-Term Manpower Forecast—Aggregate

While the figures we have been discussing have all been dollar-figures, adaptive forecasting is applicable to *any* set of successive data over time. This will be illustrated with respect to a set of data used to forecast manpower requirements.

The acquisition program is a multibillion, multinational program, involving 62 countries. One unusual feature of the acquisition is the surge requirements generated by large orders for immediate supplies. While it is known that such surges do occur, the "when" and the "where" are not. Therefore, it is hard to justify surges as a basis for increased manpower. However, if adequate manpower is not provided for ahead of time, the surge demands will have to be met out of manpower "appropriated" from other assignments, the program office receiving no reimbursements for such activities; in other words, paying for such activities "out of its own hide."

The occurrences in the past of such unallocated-for-activities make the actual manpower data inappropriate as a base for forecasts. So, a suitable surrogate has to be chosen. The multinational transactions for which the manpower is required range widely in the skills and experience demanded, a transaction involving a 10-cent item being quite different from one involving $100,000. Ignoring such significant, qualitative differences for the time being, it has been determined that the number of requisitions is a good surrogate for the manpower requirements.

We present in Figure 7 the aggregate requisitions for 24 successive quarters. They are closely bounded by the non-trend-adjusted and trend-adjusted forecasts, providing a credible basis for the manpower requirements of the 25th quarter.

TABLE III
Expected Cost Excess Control

EXPECTED COST EXCESS CONTROL
[illegible]
AGGREGATION LEVEL 0 TOTAL COST
ACTION LEVEL 1 6

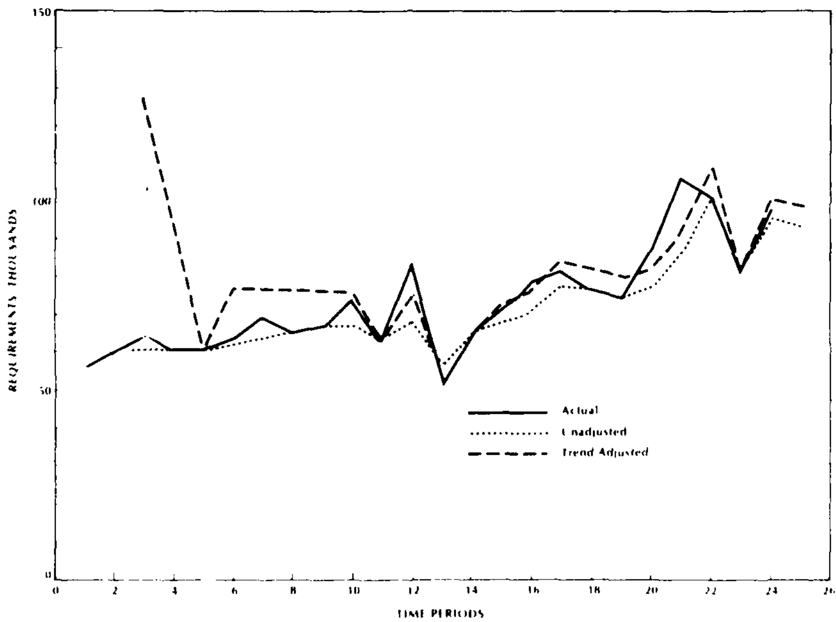
LEVEL 0 CATEGORIES						
	1	Component 1	2	Component 2	3	Component 3
	4	Component 4	5	Component 5	6	Component 6
	7	Component 7	8	Component 8	9	Component 9

LEVEL 0 COMPONENTS CONTRIBUTING MOST TO
EXPECTED VALUE OF [illegible] = EXPECTED VALUE OF A [illegible] EXPECTED COST EXCESS

RANK	LEVEL	CATEGORY	EXPECTED COST EXCESS		CONTROL FACTOR			TARGETED CONTROLS
1	1	Component 1	$ 960.1	59.0%	40.0%		>	$ 384.0
2	5	Component 5	$ 379.7	23.3%	85.0%		>	$ 322.8
3	3	Component 3	$ 184.8	11.7%	85.0%		>	$ 181.5
4	9	Component 9	$ 49.7	3.1%	40.0%		>	$ 19.9
		LEVEL 0 COST EXCESS (+)	$ 49.7	3.1%	40.0%	(AVG)		$ 19.9
		LEVEL 0 COST EXCESS (-)	$ [illegible]29.8	94.0%	70.0%	(AVG)		$ 868.3
		TOTAL COST EXCESS	$ [illegible]	100.0%	52.1%	(AVG)		$ 848.4

LEVEL 0	***** ACTION CHOICE ***** T	T+1	T+2	T+3	EXPECTED EXCESS T	TARGETED CONTROLS T	EXPECTED EXCESS T	(TARGETED - EXPECTED) SQ OVER TARGETED IN T	AVG
1	YES	YES	YES	YES	$ 994	$ 149	$ 270	[illegible]	47
2	NO	YES	YES	NO	$ 59	$ 0	$ 0	0	52
3	NO	YES	YES	NO	$ 322	$ 0	$ 0	0	[illegible]
4	NO	NO	NO	NO	$ 56	$ 0	$ 0	0	0
5	NO	YES	YES	NO	$ 221	$ 0	$ 0	0	51
6	NO	YES	NO	YES	$ [illegible]	$ 0	$ 0	0	5
7	YES	YES	YES	NO	$ [illegible]	$ [illegible]	$ 14	1	3
8	YES	NO	NO	YES	$ [illegible]	$ [illegible]	$ 26	4	2
9	YES	YES	YES	NO	$ [illegible]	$ 27	$ [illegible]	[illegible]	14

FIGURE 7
MESGRO—Actual Total



Application 6: Near-Term Manpower Forecast—Components

The aggregate requisitions are made up of requisitions originating in five different centers. These centers are the "components" of the aggregate requisitions, even as the total cost comprised nine components in the previous real-life example.

To determine which of the components contribute most to the divergence, it is first necessary to develop (planned-actual) values for the aggregate. There were no "plans" for the aggregate requisitions or for the components; therefore, a plausible plan had to be developed.

We took the actual number of requisitions of each of the components (centers) for each year and divided it by four. What we are thereby saying is that we had "planned" to have the same number of requisitions for each of the four quarters of the first year, the same number of requisitions for each of the four quarters of the second year, and so on. Clearly, these plan figures are developed with the benefit of hindsight, and are therefore closer to the actual than otherwise. The purpose here is to simply illustrate the applicability of adaptive forecasting, even in the absence of a previously developed plan.

Figure 8 presents the plan as flat segments for each of the four quarters, moving up (down) from year to year. It is bounded closely by the non-trend-adjusted and trend-adjusted forecasts.

Given the plan and the actual, we derive the excess requisitions control figures. It will be recalled that in the previous example, the cost excess was negative, signifying more being spent than planned in month 25. In the present instance, the reverse is the case: the plan calls for 3,080 requisitions more than the number required for Quarter 25.

Which components are most responsible for this excess? We find from Table VI that Component 2 accounts for an excess of 5,667; it planned for 5,667 more requisitions than required in Quarter 25. At the same time, Component 1 will be *short* by 751 requisitions, and Component 4 will be short by 142 requisitions. The latter shortages can be compensated for by the more than enough excess experienced by Component 2. Perhaps the manpower available at Component 2 could be handling some of the transactions at Component 1 and Component 4.

Application 7: Far-Term Dollar Forecast—Monthly

Applications 1 through 6 dealt with near-term forecasts—both dollar and non-dollar. We now turn to far-term forecasts.

To test the capability of adaptive forecasting, the major system acquisition program office chose to give data for six months. When it was discovered that half of the eight Components had 0 as the entry for the first five months, the data-points were extended to 11 months. The program office had the data for 28 months, and wanted to see how well adaptive forecasting could match the actual experience.

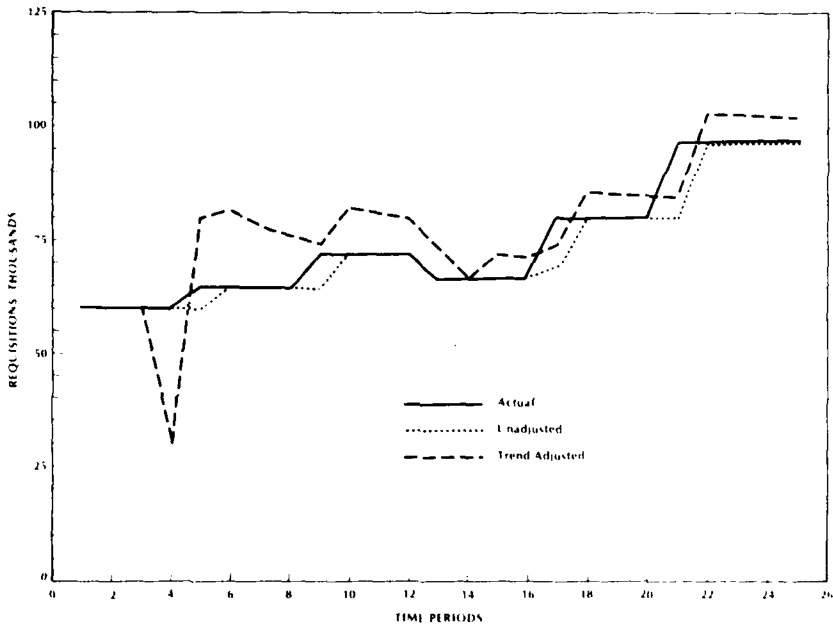
Figure 9 presents the *near-term* forecast, i.e., month 12. As before, the non-trend-adjusted and the trend-adjusted forecasts bracket closely the given data.

Given n data-points, adaptive forecasting provides forecasts for $(2n-12)$ data-points. With $n = 11$, there are 20 data-points for which forecasts are made. Of course, the "forecasts" of the data-points 3, 4, . . . ,11 are already known and serve as a test of adaptive forecasting in generating forecasts. The forecasts for the data-points 12, 13, . . . ,20 are forecasts in the true sense, since only the program office had the actual data.

To forecast data-points 12 through 20, the algorithm has to be given a maximum point higher than the highest point yet reached. This figure can be based on any number of different bases, or chosen arbitrarily. Looking at Figure 9, we see that $1.2 million was the highest figure yet reached. Therefore, we chose a slightly higher figure of $1.5 million as the maximum value.

If the maximum value given is well beyond the experience to date, such as $10 million, the algorithm will ignore that value, and proceed to make a forecast con-

FIGURE 8
MESGRO—Planned Total



sistent with the experience. What the algorithm is being asked to do is to use the experience to date and arrive at the specified maximum value. We find that $1.5 million will be reached in month 14.

Once the maximum value is reached, usually, the data-points will remain at that level for a while before coming down. However, to be conservative, *adapative forecasting algorithm* is told to come down from the maximum right away. How should the curve descend? Two alternate paths are provided—One, use the first half of the data (months 1-5), called the "remote experience," signifying the remoteness of the data from the last month of actual data, i.e., month 11; two, use the second half of the data (months 6-11), called the "recent experience," signifying the recentness of the data from the month 11. The forecasts using these two bases provide the boundaries of the future.

TABLE IV
Expected Cost Excess Control (Non-Trend Adjusted)

AGGREGATION LEVEL 0. TOTAL
ACTION LEVEL 1 - 5

LEVEL 0 CATEGORIES						
1	Component 1	2	Component 2	3	Component 3
4	Component 4	5	Component 5		

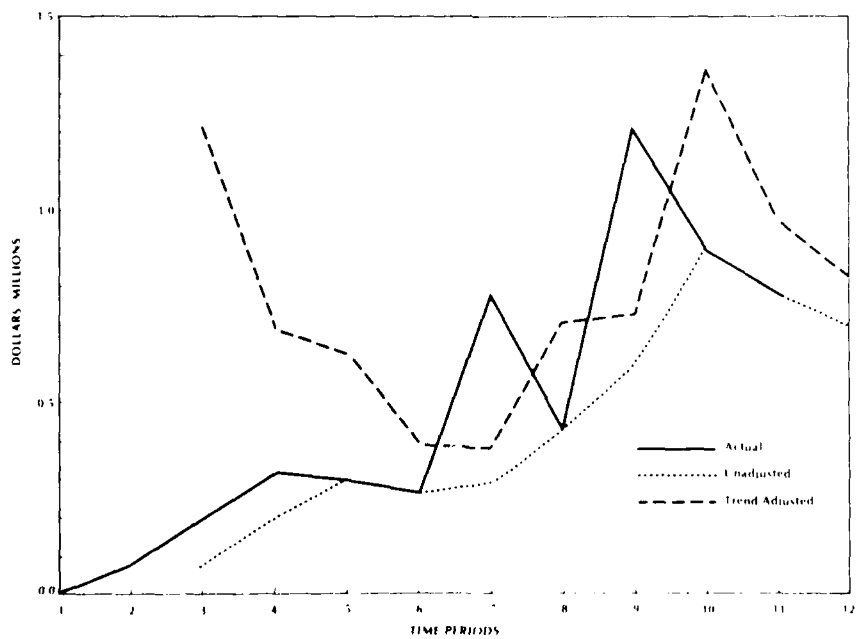
EXPECTED VALUE OF BCWP(T+1) - EXPECTED VALUE OF ACWP(T+1) = EXPECTED COST EXCESS

RANK	LEVEL	CATEGORY	EXPECTED	INCREASE	INCREASE FACTOR		TARGETED INCREASE
1	2	Component 2	$ 5666 6(	184 0%)	70 0%	--->	$ 3966 6
2	1	Component 1	$ -751 1)	-24 4%	85 0%	--->	$ -638 4
3	4	Component 4	$ -142 1)	-4 6%	85 0%	--->	$ -120 8
		LEVEL 0 COST EXCESS (+)	$ 5666 8(	184 0%)	70 0%	(AVG)	$ 3966 8
		LEVEL 0 COST EXCESS (-)	$ -893 2)	-29 0%)	85 0%	(AVG)	$ -759 2
		TOTAL COST EXCESS	$ 3080 5)	100 0%)	104 1%	(AVG)	$ 3207 4

LEVEL 0	***** ACTION CHOICE ***** T	T-1	T-2	T-3	EXPECTED INCREASE T-1	TARGETED INCREASE T-1	OBSERVED INCREASE T-1	(TARGETED - OBSERVED) SQ OVER TARGETED IN T-1	AVG
1	NO	NO	YES	NO	$ 224	$ 0	$ 0	0	20
2	YES	YES	YES	NO	$ 5631	$ 1971	$ -3599	597	650
3	NO	YES	YES	YES	$ 1723	$ 0	$ 0	0	797
4	YES	YES	YES	NO	$ -167	$ -134	$ -27	0	51
5	NO	NO	YES	YES	$ 41	$ 0.	$ 0	0.	955

What is the significance of the far-term forecast to the program manager? In the near-term, the non-trend-adjusted forecast is depended upon for its accuracy, i.e., the *magnitude* of the forecast. In the far term, however, it is the *direction*—the shape of the curve—that is the contribution of adaptive forecasting. Thus, the high and low points of the far-term forecast are particularly important; they foretell the most likely ups and downs of the program, based only on the experience to date. The program manager can—and must—superimpose on the projected profile his own special knowledge of circumstances that are scheduled to take place in the future, such as any add-on element that is likely to materialize. The strength of the near-term forecast is derived from its *validation*. Since validation is performed by comparing the forecast with the actual, and since the actual data are not available from the future, there can be no validation in the case of the far-term forecasts. While not validated for the magnitudes in the

FIGURE 9
MESGRO—Actual



future, the direction of the far-term forecasts can indeed be a most useful aid in the planning by the program office.

Figure 10 presents the far-term forecast through month 20. An interesting feature of the forecast is that $1.8 million is forecast as being reached in month 18, followed by a steep decline. The $1.8 million figure exceeds the specified maximum of $1.5 million. What the forecast says is that, based only on the recent experience, a high value of $1.8 million will be reached. While the actual date shown is month 18, it should be read as the forecast that $1.8 million will be reached once during the period, months 12 through 20.

What is the track record? In Figure 11 we present the actual data for months 12 through 20. Notice that the actual data trace a path right through the middle of the ragged boundaries set by the forecasts based on recent and remote experiences.

FIGURE 10
Extended Program Profile — Actual

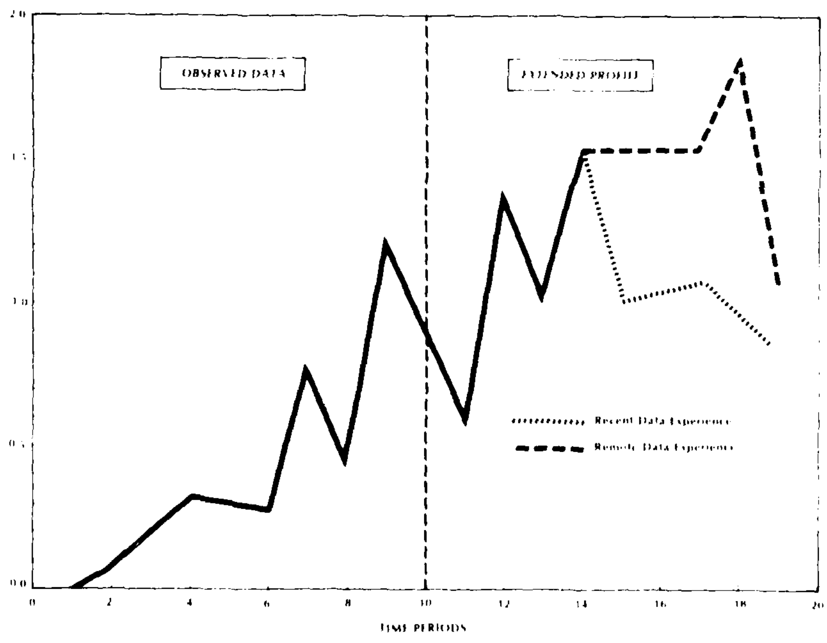
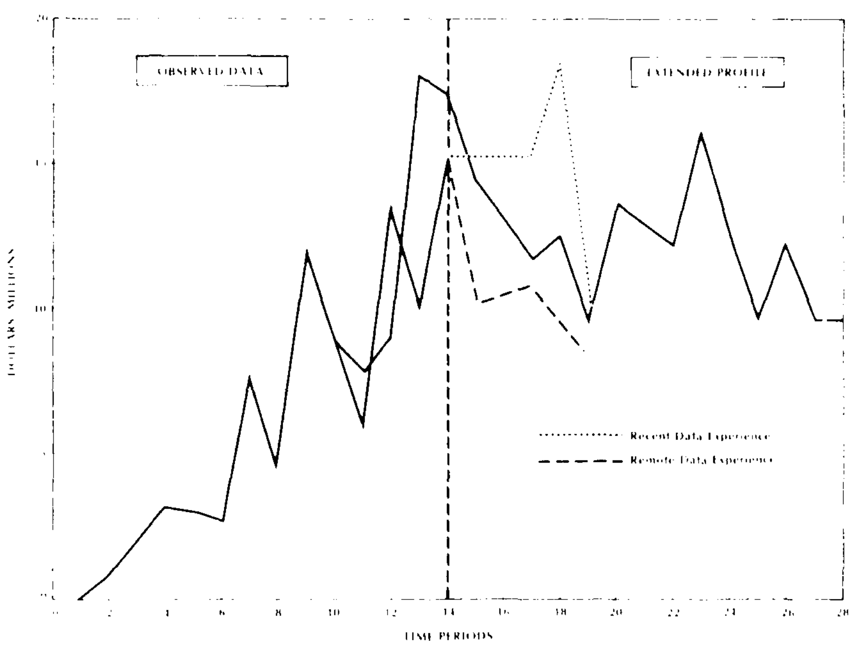


FIGURE 11
Extended Program Profile—Actual



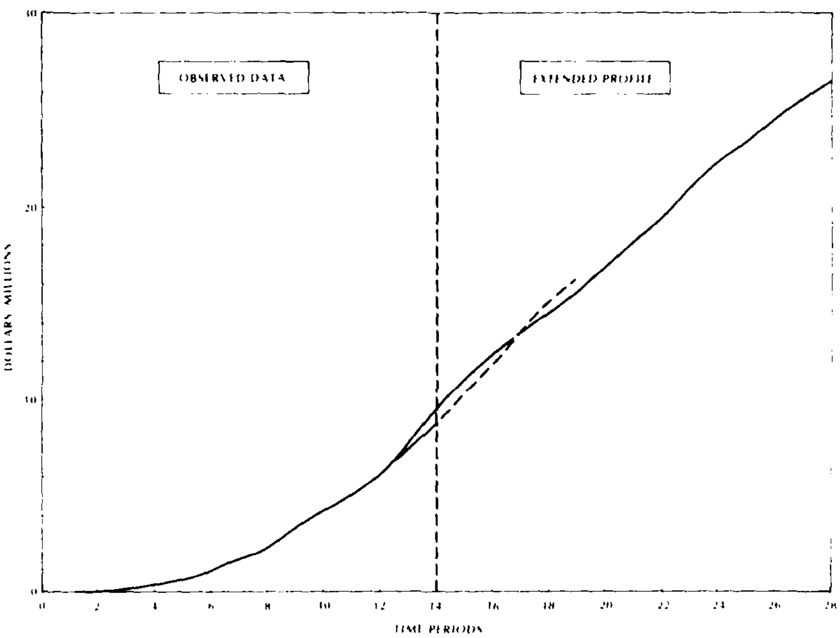
Even more striking is the $1.8 million forecast being "right on the money"; and true to the forecast, the $1.8 million is followed by a steep decline immediately. Notice that the program manager was told in month 11 that he should expect a jump to $1.8 million.

Application 8: Far-Term Dollar Forecast—Cumulative

Of even greater interest to the program office was the record of adaptive forecasting on the cumulative extended profile.

Figure 12 presents the cumulative actual data for the months 1 through 11. Shown in broken dotted line is the adaptive forecasting cumulative forecasts, which coincides with the actual in months 12, 13, and 18, and diverges by less than $10,000 to a base of $16,000,000 in the other months, resoundly testifying to the dependability of the forecast that the program manager can indeed use with confidence.

FIGURE 12
Cumulative Extended Profile



Proven Usefulness for Program Controls

The eight applications of adaptive forecasting to ongoing major systems acquisition program data indicate the capability of the method to generate highly accurate near-term forecasts, both of dollar and non-dollar data. While the near-term forecasts provide the program office with accurate *magnitudes*, the far-term forecasts provide dependable *direction*.

Using accurate forecasts of planned and actual, budget and actual, or BCWP and ACWP, the expected excess cost of the program as a whole is developed. Given the expected excess, which particular component(s) should be controlled; by how much?

The same principle employed in developing expected cost excess is also applied to expected schedule slippage, the basis being expected BCWP expected BCWS. Given the schedule slippage, the particular components which need to be

AD-A102 624 DEFENSE SYSTEMS MANAGEMENT COLL FORT BELVOIR VA F/G 5/1
CONCEPTS. THE JOURNAL OF DEFENSE SYSTEMS ACQUISITION MANAGEMENT--ETC(U)
1981
UNCLASSIFIED NL

2 OF 2
AD A
102624

END
DATE FILMED
9-81
DTIC

controlled to restore the schedule—partially or fully—can be identified. The realistic extent of restoration possible is identified with respect to each major component.

Not only for the near-term, but also for the far-term, usable forecasts are provided the program office. The shape of the curve in the future is seen to be dependable, so that the program office can plan well ahead to bring about changes in the program in the preferred direction.

97

Corporate Strategy and Tactics: Military Analogies

Dr. Douglas M. McCabe

It is essential that businessmen, in their increasingly popular use of the term "strategic management," preserve the military distinction between "strategy" and "tactics." The first part of this paper considers this distinction as it is applied in both the military and the business world. The second part deals with the applications of the so-called "classic principles of war" in business and industry.

Relationship between Strategy and Tactics

The strategist is concerned with winning wars, while the tactician has the more limited task of winning battles. Ideally, strategy is the function of top management, while tactics is the domain of middle and lower management. The strategists in an organization should be responsible for establishing overall objectives and plans. The tacticians should be given the responsibility for carrying out those plans, relying on their know-how in the various technical specialties (infantry or artillery in the military, accounting or purchasing in business).

It would be a mistake to assume that top management always confines itself to developing and carrying out a broad strategy. The executive who most frequently blurs the distinction between strategy and tactics is the one who is reluctant to delegate authority to tactical subordinates. He bogs down in the indispensable-man syndrome, taking direct command of daily firefighting, and in the process neglecting his long-range strategic responsibilities.

Generalists and Specialists

The true business strategist is a generalist, whereas his tacticians are specialists in such areas as research, production, industrial relations, marketing, and finance. The business strategist must know enough about the various specialties to be able to comprehend their capabilities and limitations with respect to his strategic plans, without necessarily being an expert himself.

The business strategist resembles an army division commander who, while not necessarily an accomplished artilleryman, for example, must know the personality of his artillery officer, and be familiar with the number, firepower, mobility, and basic tactical uses of the cannon at the latter's disposal. The tactician, in turn, cannot do the best job of which he is capable unless he is granted considerable freedom of action and on-the-spot decision-making authority. As mentioned earlier, this involves, on the part of the strategist (and higher-level tacticians), the

Dr. Douglas M. McCabe is an Assistant Professor of Management at the School of Business Administration, Georgetown University. He received a Ph.D. degree from Cornell University's School of Industrial and Labor Relations, and is a member of Phi Beta Kappa. Dr. McCabe studied military strategy and tactics at the U.S. Army Armor School, Fort Knox, Ky.

ability to delegate authority. On the other hand, responsibility, as military officers are taught to realize, cannot be delegated; a superior must always bear responsibility for his subordinates' mistakes.

Strategy Decides "What"—Tactics Decides "How"

The interrelationship between strategy and tactics is best expressed in a simple formula: Strategy determines what is to be done; tactics determines how to do it. General Douglas MacArthur's strategy for conquering the Japanese army was to leapfrog the Pacific islands, but it was his tacticians, each making numerous on-the-spot decisions pursuant to his delegation of authority to them, who did the job. Similarly, the president of a company may determine, for example, that for the company to be viable, it must capture the California market. It is then up to the sales manager, a tactician, to carry out that strategy.

Strategy and Tactics in the Civil War

An instructive example of strategy-tactics functioning in close coordination is the American Civil War, although only on the Northern side. The South's opportunities for strategic activities were severely limited by shortages of manpower and material (using hindsight, it may be said that the South's proper strategy was not to have instigated the war in the first place by firing on Fort Sumter). It is significant that General Robert E. Lee's reputation in military history is as a great tactician (winner of isolated battles), while the South's strategist, Jefferson Davis, failed seriously in securing the support of the British Empire.

On the Northern side, the first half of the war was fought largely without strategy, aside from blockading the South's coast and endeavoring to keep the British neutral. The Northern armies maneuvered only tactically, lacking strategic coordination. President Lincoln, the top strategist, was not at fault, being unable to find tactical commanders other than ones who would fight only defensively, the battle of Gettysburg included. At that mid-war battle, the North's General George Meade pummelled Lee so hard, although only defensively, that Lincoln telegraphed Meade that the war could be ended right there if Lee's withdrawing troops were vigorously pursued. Meade did not pursue.

On that same day in the West, General Ulysses S. Grant, the only Northern general who was winning battles, took Vicksburg pursuant to Lincoln's strategy of reducing the South's western boundary by gaining control of the Mississippi River. Ironically, Grant's military superiors deemed his long and desperate siege of Vicksburg hopeless because he was violating a sacred military maxim: Never fight beyond reach of your supply lines. After the war, Grant commented on Gettysburg, stating that if one of his two most capable subordinates, General George Sherman or General Philip Sheridan, had commanded at that battle, he would have pursued and destroyed Lee. For them, as for Grant, pursuit was instinctive.

The lesson for businessmen is that strategy is necessary to coordinate tactics, and that a strategist is no better than his tacticians enable him to be.

Lincoln had no aptitude tests for his generals, and probably would have distrusted any, realizing that actual performance is the only true test. So Lincoln watched Grant and, after the latter replaced a losing general at Chattanooga and won a stunning victory, made Grant his top military strategist, with command of all Northern armies. Lincoln said to Grant: "I don't want to know your strategic plans; I might inadvertently tell someone." That was incomparable delegation of authority—to a man who had demonstated that he was most probably able to handle it. But Lincoln was unavoidably gambling with the theory that a promoted man will have "transference of skills," there being no certainty that Grant, a successful tactician, would be a successful strategist.

The taking of Vicksburg holds a special lesson for businessmen—the need to be awake to opportunities to profit by breaking with tradition. Just as Grant cast tradition aside at Vicksburg by fighting beyond reach of his supply lines, so did W. P. Wrigley of chewing-gum fame break with tradition in marketing his product. While most companies made marketing departments adjuncts of production facilities, Wrigley said he was operating a sales company in which his chewing-gum production was a mere adjunct. Coca-Cola follows that same strategy.

Grant's Strategy

Grant developed a strategy for the destruction of the South's capability to engage in warfare. To each of his major tacticians, Meade, Sherman, Sheridan, and Thomas, Grant assigned a specific tactical phase of the strategy. Following proper strategic procedure, he told each *what* to do, without meddling in the tactical area of *how* each was to do it.

"Meddling" is the correct word there. Top management cannot successfully wear two hats, a strategic one and a tactical one. The classic definition of an executive is "one who gets things done through others," that is, by delegating authority to specialist tacticians. Delegation of authority is effective because it places the burden of effort where it belongs; that is, on subordinates, in a pressurized environment where they must either *get results* or *get fired*.

Meade's assignment was to wear down Lee's army in battles of attrition. Thomas' assignment was, likewise, to neutralize a Southern army in Tennessee. The assignments of Sherman and Sheridan were economic-military: to devastate the South's economy in Georgia and Virginia respectively, and, at the same time, hold at bay two Southern armies. Each subordinate accomplished his assigned mission, ensuring the success of Grant's strategy.

Once the strategist makes assignments among his tacticians, he faces a twofold task: first, to ascertain that the tacticians are on schedule and are coordinating their efforts, and second, to determine, over time, whether the strategy requires modification.

Grant once became impatient with Thomas, deeming him to be behind schedule in attacking his opponent. Thomas, who a year earlier had earned the title "Rock of Chickamauga" as the stubborn rear-guard division commander in a Northern army's retreat, refused to be hurried. It was not until Grant was on the verge of firing him that Thomas was satisfied that his exhaustive preparations for battle were completed. The result of Thomas' consummate tactical planning in this instance was that the opposing army was the only one totally annihilated on either side during the Civil War. The lesson here is: A strategist must be certain that he is correct in his appraisal of his tacticians.

Initiative—The Key to Successful Tactics

Inasmuch as initiative is one of the essential characteristics of a military or business tactician, it is appropriate to mention the North's Steward Granger. At Chickamauga, Granger commanded a brigade in Thomas' division. Thomas had ordered Granger to hold his brigade in reserve at a distance from the battle. That order literally meant that Granger must do nothing except await further orders. "Orders are orders" in the American military tradition and, as such, are inviolable. On one occasion in the Civil War, a hard-pressed Northern division commander asked a nearby idle division commander for assistance, only to be told: "Sorry. I have no orders to help you." On the contrary, in World War I, the French army, said to be the best in the world at that time, had a standing operating procedure (SOP) that officers would not obey the orders received, but rather the orders which, in their professonal judgment, they would have received if their superiors knew what the subordinates knew about their local situations.

Granger could have written that SOP. Although his ears told him that a major battle was in progress, no messenger had arrived from Thomas. Had a messenger been sent, but captured or killed? All that Granger knew was what he shouted to his staff: "Thomas needs me!" Today, in the museum at that Tennessee battle site, there is a photo with the caption: "Gen. Steward Granger marching without orders toward the sound of battle." And he did it *without orders*—that is superb initiative!

That recalls Napoleon's SOP for his corps commanders, his famed Marshals of France: "March always toward the sound of the guns." And he added a significant corollary: "Every soldier of France carries a marshal's baton in his knapsack." Henry Ford had a similar idea. During the decade when he was making his 15 million Model Ts, Ford's company was expanding so explosively that he deemed the previous day's methods obsolete, and today's methods experimental. In such strategically planned turmoil, devised to achieve minimization of production costs (customers, he said, could have any color they wanted provided it was black), Ford could not tolerate job titles. Titles, he said, would limit initiative. Ford's SOP to all executives was to ignore what they thought was the scope of their jobs, and whenever something needed to be done, to step in vigorously and do it.

Most business strategists probably shudder at delegating that much authority and demanding that much initiative. They hire management specialists to devise complicated organization charts and restrictive job titles and job descriptions in the belief that this is the way to control their organizations. Is such a straight-jacketed organization able to operate at maximum efficiency? A former chairman of the board of General Motors thought not, saying that the hardest part of his job was to issue instructions down through the channels of his organization and get them carried out. Ford, on the other hand, during constant strolls through his plant, freely issued instructions to a foremen or employee (although he was careless about informing affected superiors). At the other extreme from Ford is the highly bureaucratized nation in which, a commentator recently noted, as much as 3 years is required to coordinate the bureaucracy and arrive at a committee-style decision for a problem in a state-owned factory.

Completed Staff Work

There is one phase of the relationship between a superior and his subordinates in which the military is more efficient than the business world. In military parlance it is called "completed staff work." In business it is not discreditable for a subordinate to say to a superior: "Here is a problem. What should we do about it?" But a general officer, if a subordinate approaches him in such a matter, growls: "Bring me answers, not questions!" What the general means is that when the subordinate sees a problem (except, of course, in a hectic battle situation) it is his responsibility to think it through, find a solution, and put it on paper. To this, the general needs only to add one of two words: "approved" or "disapproved." That is what the military means by "completed staff work." It enables the superior to get things done through others, and to successfully "pick the brains" of his subordinates.

Business and Military Education

The military is considerably more efficient in educating its middle (officers) and top (generals) management than is the business world. Officers and generals go to school constantly throughout their careers, partly in formal military schools and partly by frequent job rotation into positions offering on-the-job training in various phases of military science. The business world cannot afford comparable time and cost; moreover, the principal activity of the military services in peacetime is not performing its primary function, but merely training personnel and maintaining units at a high level of efficiency for the performance of its primary function (war).

Nevertheless, a business firm should take the educational system of the military as its model. The closest approach in business to the military's many and varied schools is when some large firms send promising junior executives to a university for a master's degree or, at least, to seminars in business administration. Some firms also have executive development programs that offer job rotation for training purposes, though these programs are not nearly so extensive as in the military.

Another vital difference between the military and business in the executive ranks is the up-or-out promotion policy of the military. An officer must attain each grade (rank) by a specified age or be discharged. There are no 55-year-old captains in the Army, whereas business firms retain their executives until the normal retirement age.

It is also interesting to compare civilian and military educational systems. The service academies are engineering rather than military schools, with actual military instruction limited largely to summer camps. This renders an academy graduate qualified to be only a second lieutenant. Real military instruction begins only after graduation in one of the tactical schools (infantry, for example), giving the student the equivalent of a bachelor's degree in military science. The equivalent of a master's degree is obtained in the command and general staff school, while the equivalent of a Ph.D. degree (the strategy level) is granted by the war colleges. In terms of formal education for their jobs, few business top executives can compare with a general or an admiral.

THE CLASSIC PRINCIPLES OF WAR

The first part of this article was concerned with the critical distinction between strategy and tactics in the business world, using military science as a practical guideline. Subordinate comparisons and contrasts between business and the military were considered. Let's now turn our attention to a special feature of military science that is worthwhile for businessmen to adapt, that is, the "classic principles of war," which have some applicability in competitive economics.

The principles of war were codified in classic form by General Karl von Clausewitz (d. 1831), a military theoretician (he never commanded in battle) and the military instructor of the Prussian crown prince, Frederick William.[1] It was Clausewitz who defined war by the famous phrase, "a mere continuation of [government] policy by other means."

An example of Clausewitz's relevance to business competition is the strategy used some years ago by a leading soft-drink company. The company, thinking it had the Texas portion of the market securely in hand, stopped advertising there. A smaller company, seeing the advertising vacuum, rushed in with its own advertising, with the result that the larger company regained its position only after costly and time-consuming effort. Clausewitz, in effect, had predicted the failure of the larger company's business strategy: "The keystone of the whole defensive theory [is] never to depend completely on the strength of the terrain [a well-

1. Carl von Clausewitz, *Principles of War*, edited by Hans W. Gatzke (Military Publishing Co., Harrisburg, Pa., 1942).

established sales territory] and consequently never to be enticed into passive defense [cessation of sales and advertising effort] by a strong terrain."

A comprehensive application of the principles of war to economic theory would fill a book. It must suffice here to enumerate some of these principles, in the hope that some economists will be inspired to study Clausewitz and other military minds, and to apply their thinking to business and industry.

The Principle of the Reserve

A military commander never commits all his resources initially in a strategic or tactical situation. He holds back a reserve of manpower and material for unforeseen developments. This is one of the principles of war most commonly practiced by businessmen, as evidenced by their concern with maintaining substantial cash reserves. Another example is the holding of a newly developed product on the shelf until it can be most advantageously used against competitors.

The Principle of the Defense

Some companies have the strategic policy of being content with their performance if they maintain their accustomed percentage of their industry's market year after year. If their policies are merely reactions to competition, they are on the defensive. Clausewitz does not condone such a practice; in his view, the function of a defensive position is merely to provide time and opportunity to assume an offensive posture.

The Principle of the Offense

This is the most important of the principles. All the others serve it, as it alone can ensure victory. Its essence is incessant aggressive action, never granting an opponent the opportunity to take an offensive posture. In the business world it is seen notably in the breakfast cereal, novelty, and toy industries, in which a company's proliferation of new products dazzles customers and frustrates competitors. Ferdinand Foch, the supreme commander of the Allied armies in World War I, said while a professor at the French military academy that the principle of offense consists of three elements—"Attack! Attack! Attack!" This is the principle behind karate, which may be the purest and most perfect form of offensive action. A boxer punches and then, as often as not, stands back with his arms raised defensively. In karate, Foch's dictum is adhered to—a blow to the head, followed in a split second by a kick in the groin, and in the next split second by a chop with the side of the hand against the neck, thus keeping the opponent off balance and unable to counterattack. The feature that makes karate a fearsome thing is not so much the variety of the blows, but their staccato, split-second timing, no one being unusually dangerous by itself.

Sheridan, a small man (5 feet 5 inches tall and about 145 pounds), had a karate temperament. He would have been discharged from West Point because of his campus fist fights had not an officer suggested that if ever there were a war Sheridan would be a good man to have around. During the Civil War, Southern generals found that to attack Sheridan was to invite an instantaneous and vigorous counterattack, even if he was outnumbered. It is not surprising, then, that Grant gave Sheridan command of the task force which, in the final month of the war, pursued Lee in his retreat from Richmond to Appomatox, where he surrendered.

The lesson for businessmen is that they must constantly be on the offensive; that is, that they must be aggressive in making and implementing policies if they are to maximize their opportunities.

The Principle of Surprise

The most powerful weapon in the arsenal of a military commander, and sometimes of a business firm, is the element of surprise. This is why research and development are conducted behind locked doors. Standard military procedure is never to attack a stronger opponent unless surprise can be used to balance the scales. Early in the Civil War, while Sheridan was a regimental commander, he was outnumbered in one engagement about three-to-one. He summoned his cavalry captain: "Get around behind those so-and-sos with your men and then charge headlong back through them to my position here. Don't try to kill anyone; but just scare them to death with the most noise you can make." The order was carried out, and the enemy commander panicked and immediately retreated.

The Principle of Concentration of Mass

Surprise is not always possible, and when it isn't, sheer superior power must be amassed against a military opponent or business competitor, preferably against his weakest point. It was the principle of concentration of mass which motivated Napoleon to issue his "March toward the sound of guns" SOP. A business example is concentrating an advertising budget for a new product in a carefully selected, geographically limited trade area.

The Principle of Economy of Force

Never send a man to do a boy's work. In other words, never squander time, money, energy, manpower, and material by using them more lavishly than absolutely necessary. The classic military example of this principle is guerrilla operations. Mao Tse-tung, with a communist minority, waged a civil war in China using guerrilla methods. His policy was stated thus: "My strategy is one against ten [meaning his minority status], while my tactics [battles] are ten against one [meaning that his guerrilla troops concentrated against smaller and isolated enemy forces]." Mao was thus combining two principles, economy of force and concentration of mass.

The most economical guerrilla tactics involve using forces smaller than those of the enemy and making up the difference through the principle of surprise. The South's Colonel John Mosby used this technique in the Civil War with dramatic success, using a mere handful of men in hit-and-run jabs at considerably larger forces. Mosby boasted that on one occasion with 17 men, and on another with 20, he kept a Northern general's brigade of 3,000 men busy in fruitless pursuit. The brigade chased Mosby not because he was important, but because he was a nuisance, a thorn in their side. Mosby's objective, or course, was not to do battle with the brigade, but simply to keep them from doing more important work for the Northern cause.

Possibly the best example of guerrilla tactics in business is advertising a "sale price" for a few items in a large retail establishment, thereby attracting customers away from competitors. Another example is the tactic whereby a small company concentrates all its efforts toward capturing a small or specialized portion of a market generally controlled by others.

The Principle of Unity of Command

Unity of purpose, unity of means, and unity of control are desiderata in military and business operations. In the absence of clear unity of command vested in a single person, excessive reliance must be placed on the cooperative spirit among the participants. Higher-level executives are usually strong-willed men, and it is not always easy for them to subjugate their thinking to that of others. In the last analysis, cooperative action is committee action, with all the shortcomings associated with committee decisions. As late as World War II, the British were committed to relying on cooperation among their own top military leaders rather than on unity of command. Nevertheless, they saw the wisdom of placing themselves under the command of France's Ferdinand Foch in World War I, and America's Dwight Eisenhower in World War II.

The Principle of the Objective

"Objective" here means a strategic or tactical goal. It is not always easy for a military or business executive to clearly and correctly define his goal. Many of Lincoln's generals believed that their objective was to "take Richmond," capital of the Confederacy. Lincoln had to repeatedly remind them that capturing Richmond would accomplish little if Lee's army were still marching and fighting. Their proper objective, Lincoln insisted, was the destruction of Lee's army.

At the turn of the century, most wagon companies saw their objective as "making wagons." Only one, Studebaker, had the vision at the dawn of the automative age to see that his true objective should be "make vehicles," whether or not they were "horseless carriages." Could it be that with Volkswagens and Toyotas flooding the American market today, the automotive "Big Three" have a muddled idea of what their true objective should be?

Conclusion

This is but a brief survey of the analogous relationship between the military and business fields at the strategic and tactical levels, and of the applicability of the classic principles of war to competitive economics. If anything stands out, it is the vital importance of having highly qualified and energetic executives at all managerial positions, with those executives molded into an efficient team. It was such a team that Andrew Carnegie, founder of the steel industry, had in mind in his statement about his company's organization: "Take away our factories, take away our trade, our avenues of transportation, our money. Leave us nothing but our organizations, and in four years we shall have re-established ourselves." Carnegie's boast of the quality of his executive team was undoubtedly justified. One of the most important questions on the financial pages today is whether Chrysler has a comparable team.

One of the essential ingredients of such an executive group is that immeasurable quality called the "human spirit." Young Walter Chrysler had it. When he displayed the mock-up of his "dream-car" at an auto show in the hope of obtaining financial backing, he had no money, nor even an engine to place under the hood; all he had was an idea. His name deserves to be preserved on America's highways.

When the chronicles of military and business success are analyzed, we find that the highest acclaim is reserved not for those who made the best use of their resources, but for those who, lacking resources, filled the vacuum with copious doses of the human spirit.

To paraphrase an adage, sheep led by a lion are stronger than lions led by a sheep, but beware of lions led by a lion—and of superb tacticians led by a superb strategist. ‖

107

Some Observations on the Acquisition Status Briefing

Major Bedford T. Bentley, Jr., USAF

The Department of Defense has afforded acquisition program managers unique personal access to senior executives in recognition of the challenging problems inherent in acquiring complex, multimillion-dollar systems.[1] The effective oral presentation can be one of the best vehicles for garnering high-level support for the acquisition program. But certain recurrent questions and comments by senior executives receiving acquisition status briefings indicate that many program managers can improve their presentations by placing greater emphasis on two basic principles of speech communication: analysis of the audience's requirements for information, and refinement of the mechanics of presentation.[2] The purpose of this discussion is to share some observations on the communications process in the acquisition status briefing and to offer some recommendations for improvement.

The acquisition status briefing is no different from any other speech in terms of the principles that govern preparation and presentation. The major distinguishing feature of the acquisition status briefing is simply the content. Typically, the acquisition status briefing includes program description, management trend data, discussion of issues and problems, and assessment of program health.[3] The senior executive uses the briefing in at least three different ways: as a balance sheet to review the status of resources allocated to the program office for the acquisition, as an audit report to evaluate the program manager's effectiveness; and as a situation report to determine the impact of internal and external events bearing on program progress. Although program managers generally recognize these varied functions of the acquisition status briefing, many do not recognize one significant requirement: The senior executive's corporate outlook should be a major determinant of the content and organization of the briefing.

1. Department of Defense Directive 5000.1, *Major System Acquisitions* (Washington: Department of Defense, 19 March 1980), para. E10e.

2. I observed more than 200 acquisition status briefings during 2 years as manager of the program review process for Headquarters, Air Force Systems Command. The questions and comments mentioned in the text are those I recorded during HQ AFSC program reviews between May 1978 and July 1980.

3. USAF, Air Force Systems Command Regulation 800-1, *Command Review of Systems Acquisition Programs and Test Resources* (Andrews AFB, D.C.: Headquarters Air Force Systems Command, 22 June 1976), para. 1.

Major Bedford T. Bentley, Jr., USAF, is a student at the Air Command and Staff College. He has 7 years of experience in systems acquisition management with Air Force Systems Command. His last assignment was with the Deputy Chief of Staff, Systems, Headquarters Air Force Systems Command, where he managed the acquisition program review process. Major Bentley holds a B.S. degree in engineering physics from Cornell University and an M.B.A. from Florida State University.

The Senior Executive's Corporate Outlook

The program manager is narrowly concerned with the problems and prospects of one program, but the senior executive is more broadly concerned with the efficient application of resources across many programs. This outlook is evident in two major threads that connect many of the questions and comments directed at the program manager during the briefing. The senior executive wants to know whether the program manager is "using the system" effectively and whether the manager is complying with established policy.[4] Two examples demonstrate that neither of these areas is a trivial concern.

A program manager plagued by a structural deficiency identified during development testing of an aircraft will undoubtedly work hard to ensure that the contractor designs and verifies a suitable fix. In describing the problem and proposed corrective action during a briefing, the program manager must persuade the senior executive that the proposed fix is the best possible solution under the circumstances: The competent program manager might present a technical discussion to demonstrate that fact. The canny program manager will report that the program office has investigated similar problems on other aircraft acquisition programs, consulted with recognized government design experts on the problem, and enlisted all appropriate assistance from government laboratories. If he describes such a comprehensive attack on the problem, he is most apt to convince the senior executive that he understands how to "use the system" effectively to solve the problem.

The dynamic nature of the acquisition environment requires relatively frequent changes in policies and procedures. The recent change in DODD 5000.1 elevating supportability to the same priority as cost, schedule, and technical performance is a case in point.[5] The program manager who previously regarded supportability as a secondary consideration will not easily reverse this performance-oriented bias overnight. Senior executives must inevitably force the infiltration of this new policy throughout the program management community. A typical program manager might initially give the new policy on supportability mere lip service in the acquisition briefing. On the other hand, the canny program manager who has a legitimate case for deviating from prescribed implementation of the new policy will address the matter squarely in his briefing. He will use a solid, quantitative argument to show why the policy should be waived for his particular case. Even if it does not achieve its objective, this approach responds to the senior executive's need to confirm policy compliance. Therefore, it represents the more effective use of the briefing opportunity.

Many other examples illustrate the importance of weighing the senior ex-

---

4. These two concerns were the basis for the majority of questions and requests for additional information in AFSC program reviews during the period May 1978 to July 1980.

5. DODD 5000.1, para. D2h.

ecutive's outlook during the selection of briefing content. But the message in each case is the same: The program manager must adopt the corporate perspective if he expects to anticipate and satisfy the senior executive's requirements for information

Principles of Organization

Once the content of the briefing has been established, effective organization is necessary to ensure an effective presentation. Two conditions dictate the principles that govern an effective acquisition status briefing. The information presented in briefings is usually complex and technical, and the time allotted for presentation of data is limited. Normally, no more than 30 to 60 minutes is allowed even for programs of the highest visibility; hence, the briefing must reflect a careful distillation of factual data. The program manager's success in transmitting this information and buttressing support for his position hinges on his ability to articulate concepts and problems.

Effective presentation of concepts depends on simplicity, incisiveness, and focus.[6] Simplicity is necessary because time constraints preclude elaboration and detailed explanation of complicated relationships. Incisiveness emphasizes and gives leverage to an idea by fixing it in the recipient's mind. The incisive presentation appeals to common sense and logic and facilitates understanding of an idea. Focus strips ideas to their essentials and directs attention to the idea that promotes the briefer's objectives. Figures 1 and 2 are sample viewgraphs designed to depict the same basic concepts. Figure 1 relies on the use of words, which are often inadequate to portray precise technical relationships. Figure 2 is more effective in presenting the essential idea because it relies on the use of a diagram, an economical means of showing comparisons.

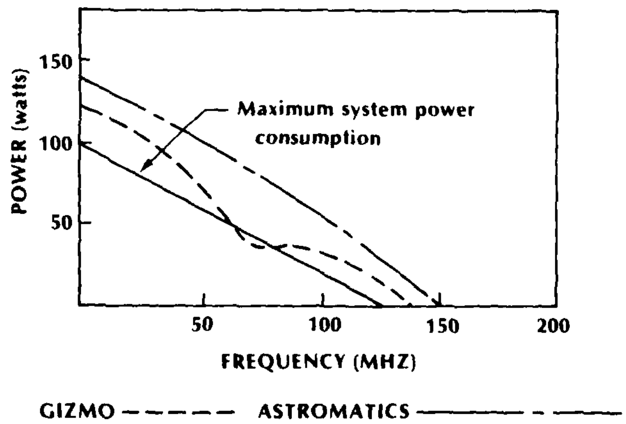
Discussion of problems must also adhere to certain essential standards to ensure effective communication: Proper identification of cause-effect relationships, full elaboration of alternatives, if appropriate, and clear presentation of recommended plans of action. Proper identification of the cause-effect relationship is the essence of the problem-solving procedure, and it is the basis for understanding the nature and scope of a problem. Too often, a program manager unintentionally directs attention to one aspect of a difficulty and receives unwanted, misdirected help when another aspect of the problem is the real source of his trouble. A program manager often knows the exact cause of his problem, but his failure to identify precise cause-and-effect relationships in his briefing misleads

6. This analysis is a synthesis of the ideas of Glen E. Mills in *Message Preparation: Analysis and Structure* (New York: the Bobbs-Merrill Company, Inc., 1966), pp. 53-55, and Stephen S. Price in *Business Ideas: How to Create and Present Them* (New York: Harper & Row, Publishers, 1960), p. 50.

FIGURE 1
Power Supply Performance

	FREQUENCY	POWER OUTPUT
GIZMO MODEL 25	0-50 MHZ 50-125 MHZ	SATISFACTORY UNSATISFACTORY
ASTROMATICS MODEL C	0-50 MHZ 50-125 MHZ	SATISFACTORY SATISFACTORY

FIGURE 2
Power Supply Output vs. System Power Consumption



NOTES: 1. Diagrams excellent for portraying precise technical relationships.
2. Diagrams are economical means of showing comparisons.

his audience.[7] Figures 3 and 4 show the impact of effective and ineffective labelings in discussing the same factual data. The generalities used in Figure 3 imply that the problem or its magnitude are not fully understood. Further, the thrust of the corrective action is ambiguous. In Figure 4, on the other hand, the problem is quantified and precisely defined, with the thrust of the corrective action explicitly stated.

The elaboration of alternatives hinges on two steps. First, the appropriate set of reasonable alternatives must be fully developed in terms of all costs and risks and associated benefits and payoffs. Program managers must resist the natural tendency to shirk the task of fully analyzing cost/benefit trade-offs for less palatable alternatives (e.g., cuts in program quantity or content to offset cost growth). For a decision-maker, an inadequately developed alternative is the equivalent of omitting the alternative. The second step is to organize the presentation of alternatives in a manner that shows differences in relative merit and explains the relationship of costs/benefits between the alternatives.[8] Figure 5 shows an example of a presentation that depicts logical relationships between alternatives.

To complete his discussion of a problem, the program manager must make a clear presentation of his recommended plan of action. Above all, he must thoroughly explain his rationale for selecting a recommended alternative. Sometimes, the selection is obvious, but the basis for selection is often not apparent. If he mishandles this final step of persuasion, he will reduce the impact of his briefing. He should be specific about implementing the recommended alternative: areas of responsibility, assistance required, tasks to be performed, and time required for completion.

Preparation of Viewgraphs and Other Supporting Materials

If letters and symbols are too small or if they show poor contrast, they can spoil the quality of a viewgraph. The best method for avoiding these problems is to test viewgraphs under conditions as much like the conditions in the ultimate briefing location as possible. The viewgraph should ordinarily contain no more than 10 lines.[9]

7. Lieutenant Colonel Howard L. McKinley, "Military Program Management: A Guide to Wonderland" (Research Study, Air War College, Air University, Maxwell AFB, Ala., 1978), pp. 50-54.

8. *Ibid.*, pp. 44-49.

9. USAF, Air University, *Guide for Air Force Speaking*, AU-1, Communication Techniques, Vol. VI (Maxwell AFB, Ala.: Air University, 1978), p. 16.

FIGURE 3
Problem - Contractor Cost Performance

• PROBLEM - UNFAVORABLE COST VARIANCE
• IMPACT - PROJECTED CONTRACT OVERRUN
• ACTION(S) - DCAS AND JAG REVIEWS REQUESTED
• GET WELL DATE - TO BE DETERMINED

NOTES: 1. Generalities imply problem not fully understood.
2. Thrust of corrective action is ambiguous.

FIGURE 4
Problem - Contractor Cost Performance

• PROBLEM - COST VARIANCE, -15%, DUE TO REWORK OF DEFECTIVE VENDOR HARDWARE
• IMPACT - POTENTIAL $2M CONTRACT OVERRUN
• ACTION(S) - ALLOWABILITY OF PRIME'S COSTS UNDER REVIEW BY DCAS AND JAG
• GET WELL DATE - 15 DEC 80

NOTES: 1. Problem is quantified and precisely defined.
2. Thrust of corrective action is explicit.

Readable viewgraphs can be developed with relatively cheap and fast vellum-acetate graphics, but fancier graphics techniques are also available. These techniques are a bit costlier and more time-consuming, but they produce the highest standards of quality. In the past several years, mini-computer-based graphic systems have entered the market. These systems generally consist of three or four pieces of hardware, including a keyboard-CRT unit, disk drive memory/control units, and a digital plotter. They can operate from floppy disks or magnetic tape storage mediums, and they offer promise of combining the functions of management information control and graphics in a single system. Ultimately, this

FIGURE 5
Program Restructuring Options

OPTION	TOTAL BUY	DELIVERY SCHEDULE	NET IMPACT ON CONTRACT COST
1. EXISTING CONTRACT	50	24 mos.	– –
2. EXTEND PRODUCTION	50	36 mos.	+ $55M
3. REDUCE TOTAL BUY	35	30 mos.	– $ 3M
4. TERMINATE PRODUCTION	10	12 mos.	– 20M

development will undoubtedly lead to push-button composition and production of variable formats from a stored data base. This type of system should be given serious consideration by offices large enough to afford the hardware investment. This equipment will be particularly worthwhile for offices already planning to computerize program office management information.

Some administrative procedures have been used very effectively to refine viewgraph presentations and to take advantage of the hard work invested in assembling a briefing. Cataloging each viewgraph for a briefing with a simple code uniquely identifies each viewgraph and, when accompanied by an index, the catalog enables the program office to locate and reuse the viewgraph in subsequent presentations. This capability is particularly important for specially developed graphics, such as schematics, pictorials, and maps. One scheme uses a sequence number, month designator, and year to code each viewgraph. For example, the third viewgraph prepared to support a briefing in October 1980 would be coded 3 J 80 (3 refers to the third viewgraph prepared; J is the tenth letter of the alphabet and designates the tenth month, October; and 80 is the year 1980). This code is generally affixed inconspicuously in a corner of each viewgraph. Viewgraphs can be easily indexed with identifying codes, viewgraph titles, and short descriptions of content, if desired. A library of viewgraphs can then be organized to satisfy future briefing requirements.

The projection schedule is a minor detail, but it can have significant consequences on the briefing. This innocuous listing of viewgraphs for the projectionist can be the source of embarrassment and disruption if, halfway through a multiple-screen briefing, the briefer realizes that the projectionist's reading of the schedule differs from his intent. To avoid this problem, the briefer should request the projectionist to read back the schedule prior to the briefing to confirm his understanding of the sequencing. He should also show the projectionist how to locate backup viewgraphs quickly when he calls for them.

An area of overriding importance in the preparation of briefings is the development of other supporting materials, i.e., written notes or data. Most briefers annotate a hard copy of the viewgraphs for the briefing with detailed background or explanatory notes representing material that may be required during the presentation. But a briefer must have other background information at his disposal. This data includes documents, diagrams, tables, chronologies, schedules, report extracts, congressional extracts, messages, letters, memoranda, and related materials that can be used in answering unanticipated questions. The trick in preparing and collecting this information is to anticipate the unexpected question.[10] The handiest package for this information is a slim three-ring binder organized by indexed dividers so that the briefer can rapidly locate the data he needs.

What specific information should be included? Basic program data is a primary requirement; significant contract clauses and terms (life-cycle-cost incentives, correction of deficiencies, performance incentives, etc.); program data (budget details, status of released funds, planned fiscal year buys, etc.); and other data as required.

One helpful device, affectionately called the "Pearl Harbor file" by some briefers, is a chronological summary of program history. Dates and associated brief descriptions of program events, not exceeding three or four sentences, are listed in order, and source papers documenting the events are identified with each entry. For a major program with a substantial history, this can be a real boon to a recently assigned program manager. For a program older than 5 years, the Pearl Harbor file may be too bulky, but in such cases, an abbreviated version may be used to cover the appropriate period.

Refining and Presenting the Briefing

Actual presentation of the briefing is the last hurdle, and, in retrospect, it may seem almost anticlimactic. There are basically two styles of delivery—the manuscript reading and the extemporaneous approach. The most impressive program managers generally extemporize, but perhaps not as spontaneously as one might suspect. Actually, only a handful of program managers actually "wing" any significant portion of their briefings, particularly for major programs. In those cases, the briefers possess unparalleled experience and technical competence. In fact, most extemporizers initially write or tape their presentations and hone the verbiage through repeated practice sessions. By the time of the final presentation, the briefer has essentially internalized his script and actually delivers what amounts to a reading despite outward appearances. However, this approach has a number of advantages over script reading. For example, the program manager's apparent command of his information enhances his credibility.

10. *Business Ideas*, pp. 148-152.

Disruptive questions are less likely during the briefing because the program manager feels less constrained by structure and can think more effectively on his feet. Furthermore, he avoids tying himself to a podium with written notes and strives to hold the audience's interest through eye contact. The overall effect is to enliven the presentation by introducing elements of naturalness and vitality. On the other hand, some experienced and highly successful program managers always read their briefings. Thus, the choice of styles is clearly a personal matter.[11]

Familiarity with the briefing environment and equipment is another way to avoid disruptive glitches during a briefing. The speaker should understand his projectionist's limitations in terms of equipment and know-how. I once attended a briefing where the remote device broke, and the program manager endured 10 minutes of embarrassment at the end of his briefing because he could not understand why the projectionist failed to respond to his urgent signals. A better-prepared program manager might have used the alternate signal button on the podium to finish his briefing. Leave no detail to chance. Is drinking water available? Can the projectionist hear the speaker from the projection booth? Can the light level be varied? Are there any peculiarities in the room—acoustics, room arrangement, etc.—requiring attention? If the speaker plans simultaneous use of three screens, are they available in the briefing facility? Where does the boss sit? Who will attend the briefing?

Four aspects of the presentation deserve special mention because they frequently lead to disruptions in the communications process: the treatment of program cost management, and business arrangements; the influence of organizational relationships; the use of visual support; and the effect of distractions.[12]

The treatment of program cost management is complicated by the fact that each of three subelements—cost estimating, budgeting, and analysis of the contractor's cost performance—has its own technical jargon and specialized rules. The briefer must explain the content of a cost estimate in precise and explicit terms; for example, he should use "then-year," "base-year," and "constant-year" dollars appropriately to address inflation, and round off estimates sensibly to account for estimating uncertainty. The key to an effective presentation on budgeting matters is an accurate portrayal of the program status in the planning, programming, and budgeting (PPB) cycle. The lead time in the PPB cycle largely determines the prospects for solving a budget problem, the seriousness of a funding shortage, and the procedure for seeking a solution to the shortage. The usual difficulty in presenting an analysis of a contractor's cost performance stems from failure to identify the specific cause of an overrun and to provide a convincing

11. *Business Ideas*, pp. 113-117 and *Guide for Air Force Speaking*, p. 21. Also see Louis Nizer's *Thinking on Your Feet* (Garden City, N.Y.: Garden City Publishing Co., Inc., 1944), pp. 35-41.

12. These four areas were the sources of the most frequent distractions commented upon by senior AFSC executives in program reviews I attended.

assessment of the impact on the total price. A comprehensive analysis requires the same rigorous approach applied to any other acquisition problem: complete identification of the cause, the total impact, and a detailed plan for correcting the problem.

Too often, program managers display a lack of familiarity with the details of significant program business arrangements. An effective presentation of acquisition strategy, contract terms and conditions, and contract administration issues requires the briefer to detail such things as incentive structures, cost-sharing formulas, and other contract provisions. The key to effective treatment of business matters is to master the details of these arrangements and have the appropriate numbers or contract language ready at hand to respond to the senior executive's question.

At times, the program manager must operate in somewhat bizarre organizational relationships; nevertheless, his charter invests him with responsibility for directing and coordinating all activity necessary to acquire and field the system. Consequently, he must be prepared to speak authoritatively about the status of spare orders, the construction of facilities, the status of government-furnished equipment, and any other aspects of program support. The fact that an external agency has prime responsibility for each of those tasks does not alter his obligation to report the status to the senior executive. Similarly, he must look beyond the confines of his own program in the contractor's plant to understand the effect of other business on his program. Thus, he should know the amount of the contractor's backlog of orders and the program's share of these orders.

Another dimension of organizational relationships is the practical matter of bureaucratic politics. The program manager must always be prepared to discuss responsibilities for resolving issues in the next stage of action and the position of each significant player on the issues. If an impasse develops, he must be prepared to suggest intervention by higher headquarters.

The use of visual support should be much more extensive in acquisition briefings. Visual aids can be very effective in facilitating comprehension of complex management and technical information. Program managers should also know that visual support improves recall and amplifies the persuasiveness of the presentation. There is a vast difference between the cognitive impact of a series of specifications listed on a viewgraph and a two-minute film clip showing a missile in the process of tracking and destroying a maneuvering tank. Demonstration hardware, models, films, still pictures, videotapes, graphs, and diagrams are excellent methods of enhancing a presentation.[13]

---

13. Douglas Ehninger, Alan H. Monroe, and Bruce E. Gronbeck, *Principles and Types of Speech Communication* (Glenview, Ill.: Scott, Foresman and Company, 1978), pp. 261-270.

The effect of distractions on effective communications is, appropriately, the last item to be considered in refining the presentation. What are some typical distractions? Jargon, unfamiliar acronyms, and unusual nomenclature; internally contradictory data or "disconnects"; and inaccurate or out-of-date information are examples of minor impediments that tend to erode the persuasiveness of a presentation. Of course, the answer to this type of problem is to involve as many dispassionate, critical eyes as practicable in dry runs of the briefing. A briefer can avoid the "forest vs. trees" syndrome by relying on personnel other than the preparing staff for quality control review.

Summary

The effective acquisition status briefing plays a critical role in acquisition management because of the program manager's unique access to senior executives. The program manager must fully consider the corporate outlook of senior executives in selecting the information to be presented in the briefing. The information must then be economically and effectively structured. An effective briefing cannot compensate for incompetent management, but a poor briefing can certainly damage the prospects of a system acquisition program.

Correspondence

118

Dear Sir:

The article, "Fielding Army Systems: Experiences and Lessons Learned," by Colonel James B. Lincoln, [*Concepts*, Autumn 1980] was interesting and thought-provoking. When the article was written, it undoubtedly contained the best information available. There are, however, several timely updates which should be noted.

One of Colonel Lincoln's major findings was lessons learned from the fielding of Army systems need to be documented, collected, and made available. As he noted, in the past lessons learned were not shared by project managers; consequently, the same or similar mistakes were often duplicated. To alleviate this situation, HQ, DARCOM, in April 1980, tasked the U.S. Army DARCOM Materiel Readiness Support Activity (MRSA) to develop a Department of the Army integrated logistic support (ILS) lessons learned program. Essentially, the program attempts to collect ILS experiences and then distribute the information to all Army logistic planners.

There are basically two products in the program. The first of these is the ILS Lessons Learned Report (RCS DRCRE-1001). This report summarized many of the lessons learned by the Army in developing and/or fielding materiel systems. It is prepared semiannually and covers the lessons identified during the last 6 months. In accordance with AR 700-127, "Integrated Logistic Support," 1 April 1981, the report is distributed throughout the Department of the Army to provide an overall awareness of the total ILS lessons learned program, and to encourage interactions/communications between commands/activities. To date two editions of the ILS Lessons Learned Report have been published (Oct 80 and May 81). Copies of these reports are available from MRSA.

The other product of the program is a set of customized reports. These are available upon request and each one is tailored to provide the collective set of lessons learned for a specific functional area, such as provisioning, publications, testing, etc. The customized reports can be used by the ILS manager to resolve problems or to conduct detailed analysis on his/her program.

The proponent for the ILS lessons learned program is MRSA. They maintain the central ILS lesson learned repository and serve as the point of contact for all requests and comments on the program. For additional information or copies of their products, the MRSA mailing address is:

Commander
U.S. Army DARCOM Materiel Readiness
Support Activity
ATTN: DRXMD-EI
Lexington, KY 40511

Telephone: Commercial: (606) 293-3393
AUTOVON: 745-3393/3627

Another of Colonel Lincoln's conclusions was that: "The practice of submitting DARCOM Form 2410-R (Questionnaire on Availability of Logistic Elements for Initial Fieldings) has proved totally ineffective as a follow-up check after fielding. . . . There is no evidence that any action has been taken by DARCOM as the result of negative 2410-R answers submitted by an IOC unit." This statement is in error. The 2410-R form is a method DARCOM uses to assess the effectiveness of DARCOM performance during initial fielding. It also provides DARCOM with valuable information on user satisfaction, concerns, and problems. Essentially, the form is a checklist that asks various questions concerning the logistic support during initial fielding. A representative of the IOC unit merely enters a checkmark in the appropriate column next to the questions. A remarks section is also provided for more detailed information on those elements which were not satisfactory.

In accordance with the materiel fielding agreement, the 2410-R form is prepared by the gaining IOC unit. Within 30 days after fielding, a completed copy of the form is forwarded to the materiel developer (i.e., project manager, materiel development command, etc.). Another copy is forwarded to MRSA. If any problems are identified on the form, the materiel developer and MRSA cooperate to correct deficiencies and improve follow-on fieldings. Based on the 2410-R and the corrective actions, the materiel developer also provides MRSA with a summary of lessons learned during the fielding. This information is collected into the lessons learned repository for sharing with other materiel developers. This action helps eliminate the perpetuation of problems and improves logistic support.

An example of the benefits of the 2410-R form may be illustrated by the fielding of the Refrigerator Container, 20 ft., SC 209. In July 1980, the U.S. Army Mobility Equipment Research and Development Command fielded this refrigerator container in USAREUR. The gaining unit identified on its 2410-R that the container had experienced considerable damage in transit. Upon receipt of the form, the materiel development command investigated the problem and assisted in repairing the damage. They also isolated the fault, studied potential design changes, and tested a number of shipping restraint devices. As a result, interim corrections were established and a modification work order (MWO) was developed. Follow-on fieldings to other units were suspended until corrections could be made. This action saved follow-on units the delays, reduced readiness, and increased costs experienced by the initial gaining unit.

In conclusion, it may be noted that Colonel Lincoln's article should be most helpful to those seeking an understanding of the Army's acquisition and fielding processes. With the addition of the information cited above, Colonel Lincoln's article is a fine reference for materiel developers and logistic planners.

Richard Stillman
Readiness Division
U.S. Army DARCOM Materiel Readiness Support Activity
Lexington, Ky.

DATE
ILMED
-8